San Francisco
Department of the Environment

San Francisco

Climate Action Strategy

2013 Update

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Letter from the Mayor

Office of the Mayor

City and County of San Francisco

October 21, 2013

I am pleased to introduce the City and County of San Francisco's updated Climate Action Strategy. Since we implemented our initial Climate Action Plan in 2004, San Francisco has made steady progress toward reducing greenhouse gas emissions—even as the city's economy and population have continued to grow. But how do we grow responsibly? The answer is by taking care of our environment. Our city has been able to achieve these results by working with residents and the business community to use cleaner electricity, invest in energy efficiency, and recycle and compost more materials.

Our progress shows that San Francisco is making strides in developing a clean and green emissions path. We continue to be well ahead of targets set by California's climate law and the international Kyoto Protocol. Still, in the eight years that have passed since we began implementing our initial Climate Action Plan, we have seen marked consequences of a warming planet. Sea levels are rising faster than projected, and 2012 marked the hottest year on record in the United States. Natural disasters like Hurricane Katrina and Hurricane Sandy exposed the great human and economic toll that climate-related disasters can bring to our communities. The need for immediate action has never been more evident, and we know that cities are leading the way.

Given the absence of action on climate change issues at the national and international levels, local action offers the best opportunity for innovation and progress. San Francisco's Climate Action Strategy update is our way of joining cities across the globe in taking responsibility for our greenhouse gas emissions by promoting policies to reduce those emissions while strengthening the local economy and creating jobs.

The residents and businesses of San Francisco in partnership with all city agencies have been critical to our success thus far. Thanks to their engagement in this process, sustainability has become part of San Francisco's values, and I look forward to working together to keep San Francisco a vibrant place to live and work for future generations.

Mayor Ed Lee

Acknowledgments

The 2013 San Francisco Climate Action Strategy update is the result of the work and partnerships between city agencies, community members, local businesses, national academic organizations, and international consultants. This collection of ideas and opportunities will enable San Francisco to do our part to cut our carbon footprint and address the challenge of climate change. Along with identifying achievable and practical solutions to meet our climate goals, this update illustrates the progress our city has made in reducing greenhouse gases over the past two decades. We are pleased with all that has been accomplished, but we know there is much more to be achieved. As we progress toward our main goals of sending zero waste to landfills, making 50% of all our trips outside of our cars, and choosing to power our homes and businesses with 100% renewable energy, the Department of the Environment will continue to collaborate with all stakeholders to ensure San Francisco remains a vibrant, livable city for generations to come.

I want to express my sincere appreciation and recognize those who participated in creating, guiding, and assembling this update. Thank you!

—Melanie Nutter, Director, San Francisco Department of the Environment

San Francisco Department of the Environment

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Executive Summary

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San Francisco has long been a leader in environmental, social, and economic prosperity. Today we confront what may prove to be the greatest challenge of our era—climate change.

Over the past two decades, San Francisco's local government, businesses, and private citizens have made tremendous progress, reducing the citywide carbon footprint by 14.5% while building the economy and improving quality of life. The city is cleaner and better! Yet there is more to do.

With the effects of climate change now being felt sooner and stronger than expected, the City of San Francisco is offering an update to its 2004 Climate Action Plan. This report provides a summary of progress and examples of successful policies and programs, and outlines a set of actions that can be taken by citizens, businesses, and government. Collectively, the following actions make up the core of the strategy:

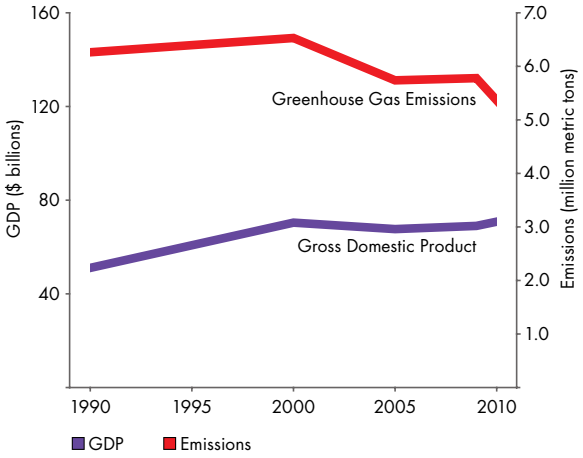
- source **100%** of residential and 80% of commercial electricity from renewable sources, coupled with energy efficiency improvements to reduce usage
- make **50%** of all trips outside of personal vehicles
- achieve San Francisco's **0** waste goal (reducing emissions from this sector to zero)

San Francisco's Leadership

San Francisco is among the leading cities that are showing the world pathways to a low-carbon economy. San Francisco's greenhouse gas (GHG) emissions reported for 2010 were 5.3 million metric tons, down 14.5% from 1990 levels. These reductions occurred even with growth in the city's economy (gross domestic product up 40%) and population (up 11%) during the same 20-year period.

The City has come close to reaching our initial GHG emissions reduction goal: 20% below 1990 levels by the end of 2012 (verified data to confirm San Francisco's emissions for 2012 will not be available until 2014). This puts San Francisco well ahead of targets set by California's Assembly Bill 32, the Global Warming Solutions Act, and the international Kyoto Protocol. As the City continues to implement effective policies regarding energy use in buildings, transportation, zero waste, the urban forest, and municipal operations, San Francisco will stay on course. Projections demonstrate that GHG emissions reduction goals of 25% below 1990 levels by 2017 and 40% below by 2025 are attainable.

Figure 1. **San Francisco's GHG Emissions Declined as Its Economy Grew**



* Estimated San Francisco County Gross Domestic Product (GDP) from Moody's in 2005 dollars

San Francisco's Progress to Date

Emissions reductions in San Francisco have come from a cleaner supply of electricity, reduced consumption of natural gas and electricity in the commercial sector, and less waste sent to landfills due to progressive increases in composting and recycling. The largest reduction came from a decreasing emissions intensity of the electricity consumed in San Francisco. This move away from fossil-fuel-based electricity is due to the State of California's Renewables Portfolio Standard and the closure of two of the state's dirtiest and most inefficient fossil fuel power plants in San Francisco's southeast neighborhoods.

Overall electricity use in San Francisco increased 11% between 1990 and 2010, but the decrease in the carbon intensity of grid electricity outweighed the growth in usage for electricity, resulting in a net decrease in GHG emissions from the building sector.

San Francisco attained an 80% waste diversion rate in 2010, which was the highest of any major city in North America. The success of the City's recycling and composting programs means that GHG emissions from waste sent to landfills are down by nearly half, compared to 1990 levels.

Emissions from personal vehicles have increased since 1990 by 4% as people make more trips and drive longer distances to work. Improvements in vehicle fuel economy—from an average of 18 miles per gallon two decades ago to 25 miles per gallon in 2010—represent a positive trend but have served to only slow the growth in emissions from transportation.

The net result of these trends in emissions across the building energy, transportation, and waste sectors is an overall reduction of 14.5% below 1990 levels.

Table 1. **GHG Inventory Trends, 1990–2010**

Metric	2010 Trend
Citywide GHG Emissions (mT CO_2e)	↓ -14.5%

Climate Change Is Already Here

San Franciscans are facing a reality where climate change is already affecting their lives. Sea level rise, reduced snowpack and more fires in the Sierra Nevada Mountains, and extreme weather events, particularly heat waves and intense rainstorms that cause flooding, are among the factors influencing the livelihood of the entire Bay Area. The most recent scientific projections show sea level increasing by 11 to 19 inches by 2050 and 30 to 55 inches by 2100. Runways at San Francisco International Airport, primary transportation arteries such as Highway 101, and miles of shoreline and parks are particularly at risk. A rise-in-sea-level scenario eventually could result in an estimated $62 billion of infrastructure damage.[1] By mid-century, San Francisco could see three to four times as many extreme heat days as occur in 2013, with related increases in hospitalizations and deaths, especially for the elderly, the very young, and other vulnerable groups such as those living in low-income neighborhoods.

Devastation, such as that in New York and New Jersey caused by Hurricane Sandy in 2012, heightens awareness of the potential threats of climate change. The East Coast was caught unprepared for a storm of Sandy's magnitude, and the resulting economic and property damage will require years for full recovery. San Francisco and the Bay Area do not experience hurricanes like the eastern U.S. Seaboard and Gulf States, but other unique and extreme weather patterns make the region vulnerable. An "atmospheric river" of powerful Pacific storms hit northern California in December 2012, dumping up to 10 inches of rain in just a few days in some areas and causing flooding in San Francisco. National Oceanic and Atmospheric Administration scientists at the Earth System Research Laboratory in Boulder, Colorado, predict that these types of violent, moisture-laden storms could become the new normal for the Bay Area.

Preparing to Adapt

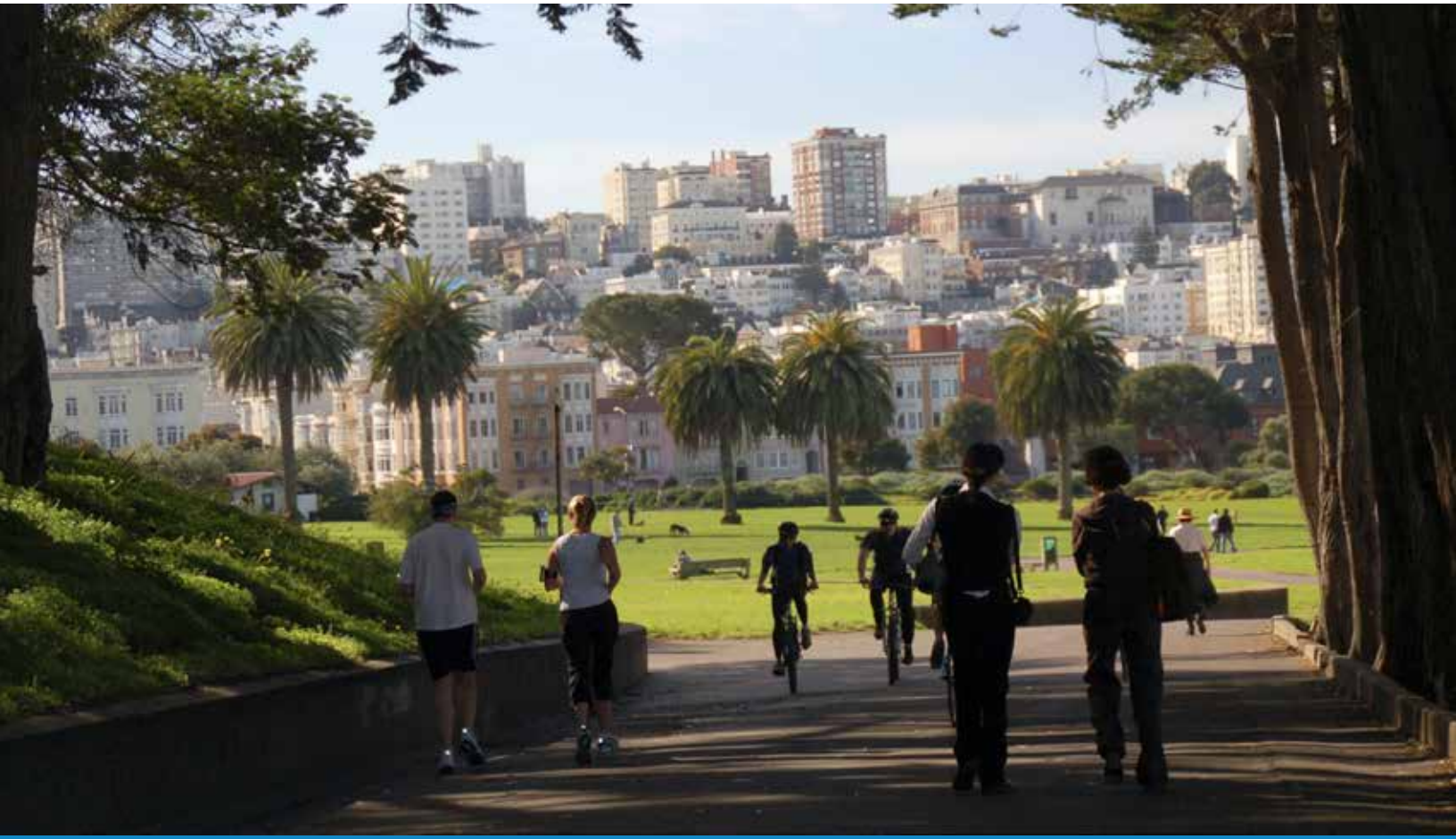
Gaining a deeper understanding of climate-related environmental and health impacts and preparing to adapt to the effects of an erratic and changing climate is also critical for San Francisco. The City is already taking steps to prepare for the effects of climate change. A multidisciplinary panel of experts from within City agencies has been brought together under the Mayor's Office. This group, Adapt SF, will propose policies and promote actions that San Francisco residents, businesses, and municipal government can take to manage climate change impacts and incorporate them into infrastructure investments and economic planning.

Cities: The Best Hope for Reducing Greenhouse Gas Emissions

As San Francisco prepares to adapt to a changing climate, the City must also remain tireless in our efforts to reduce the GHG emissions that are causing global warming. Recent studies suggest that trends in worldwide GHG emissions are pushing the planet close to a point where atmospheric and biological changes cannot be reversed and catastrophic results are likely within the century. Adaptation alone will not be adequate. California's climate and clean energy law (Assembly Bill 32, the Global Warming Solutions Act of 2006) offers exemplary guidance, with the goal to reduce statewide GHG emissions to 1990 levels by 2020. In the past seven years, the state has adopted this landmark legislation, balanced its budget, and recovered its economy. To successfully address climate change we must continue to take fossil fuels out of our economy while supporting new growth in alternative energy and fuel sources, creating new jobs, and caring for our natural and open lands.

President Barack Obama's 2013 Climate Action Plan is a demonstration of leadership and supports the tremendous work that is already taking place at the state and city level. Despite this initiative, the US Congress has not yet acted on climate change, and regretfully, United Nations negotiations for an international climate treaty have been nearly paralyzed by political differences.

The slow pace of regulatory action at international and national levels leaves cities in the best position to address GHG emissions. Globally, cities take up only 2% of the earth's land mass, but they are responsible for 80% of energy use and 70% of emissions.[2] These numbers will increase as more people move to cities during this century. City governments generally have substantial operating authority over major emission sources, such as power, transit, and waste. C40—a global group of 40 of the largest and most progressive cities (representing more than 540 million people, 8% of the global population, and 20% the of global gross domestic product)—announced at the Earth Summit held in Rio in June 2012 that city policies already being implemented have the potential to reduce emissions by 1 billion metric tons of carbon dioxide equivalent (CO_2e) annually by 2030.



San Francisco Climate Action Strategies and Key Performance Indicators

The Path Forward

As San Francisco's economy continues to grow and our population increases, we can simultaneously reduce emissions and improve quality of life by implementing the following strategies:

Energy Use in Buildings

1) Move 100% of residential buildings and 80% of commercial electricity consumption to 100% renewable electricity
2) Achieve 2.5% annual increase in energy efficiency in the commercial and residential building sectors through efficiency measures and behavior change

Transportation

3) Shift 50% of trips to non-automobile trips by 2017 and 80% by 2030
4) Grow public transportation options and expand alternative transit infrastructure
5) Expand access to clean vehicles and fuels, including
   a) Move Bay Area Rapid Transit (BART) to 100% renewable electricity
   b) Move the taxi fleet and San Francisco Municipal Railway (Muni) buses to 100% renewable fuels

Zero Waste

6) Achieve zero waste to landfills through recycling and composting
7) Reduce upstream waste through material management and producer responsibility policies

Urban Forest

8) Secure funding to maintain existing urban forest
9) Increase the canopy of the urban forest to 25% of city land area

Municipal Operations

10) Reduce natural gas use by 30%
11) Move Muni buses to 100% renewable fuels

Many of the identified GHG emissions reduction strategies are already being implemented in San Francisco. Early progress in cutting emissions has been documented, and projections show potential for future reductions through 2030 and beyond. For some strategies such as those regarding renewable energy, policy makers will need to choose among a range of policies and programs to achieve the most desirable goals. A comprehensive analysis, using the San Francisco Department of the Environment's climate model, reveals that the GHG emissions reduction projected from all major strategic efforts will total 2 million metric tons of CO_2e annually by 2030, compared to maintaining the status quo. These strategies are predicted to put San Francisco's carbon footprint at 2.9 million metric tons of CO_2e in 2030, or 44% below the 1990 level. By following this path, San Francisco will beat our GHG emissions reduction targets for 2017 (25% below 1990) and 2025 (40% below 1990).

Major Policies and Programs

Moving to 100% renewable electricity is the single biggest step the City can take to reduce GHG emissions. The potential GHG emissions reduction from this program is estimated to total 941,000 metric tons (mT) of CO_2e annually by 2030. Enforcing the Commercial Building Ordinance for energy benchmarking and auditing will drive new investments in energy efficiency. This policy and other energy efficiency actions have the potential to achieve an annual GHG emissions reduction of 302,000 mT. A series of transportation-related mitigation measures, including shifting travel away from reliance on the automobile through improved public transit services and expanded bike lanes, congestion management, and increased use of electric vehicles, has the potential to cut emissions by 432,000 mT annually. Another 293,000 mT in annual reductions will be achieved when San Francisco reaches our zero waste goal, through increased recycling and composting. Protecting the urban forest with more tree planting and improved tree maintenance will have a relatively minor impact on emission levels (15,000 mT annually) but will generate other important environmental and quality of life benefits for San Francisco.

Table 2. **Climate Action Strategy List**

#	Climate Action Strategy	2030 Savings (mT CO_2e)
1	**100% Renewable Electricity**	(941,785)
	Energy Efficiency	(301,979)
2	Implement the existing commercial building benchmarking ordinance	
3	Implement energy efficiency programs	
4	Renew Residential Energy Conservation Ordinance requirement for home sales	
5	Provide loans and rebates	
6	Provide energy efficiency designs for new developments	
7	**Zero Waste by 2020**	(292,957)
	Transportation Demand Management and Pricing	(217,794)
8	Implement variable-rate road pricing in downtown	
9	Expand SFPark meter demand pricing program	
10	Convert street parking to a demand pricing program	
11	Promote transit-oriented development in priority development areas	
12	Improve public transit awareness through information integration	
13	Provide transit passes for new developments	
14	Continue parking cash-out program	
15	Increase distribution of employer transit passes	
16	Require hotel visitor transit passes	
17	Expand participation in San Francisco's ridesharing 511 program	
18	Distribute transit passes to students and staff	
19	Coordinate transit shuttles	
20	Support neighborhood travel choice programs	
21	Expand SFGO signal synchronization	
22	**BART to Achieve 100% Renewable Energy by 2030**	(89,048)
	Transportation Mode Shift	(72,154)
23	Construct a protected cycletrack network	
24	Complete build-out of San Francisco's bicycle plan	
25	Expand bicycle sharing, electric bicycle capacity	
26	Promote new development car sharing and bicycle parking	
27	Optimize transit system fleet, storage, maintenance	
28	Expand region transit core capacity	
29	Provide additional capacity for existing express transit corridors	
30	Complete Better Streets Plan	
31	**Muni Buses 100% Carbon-Free**	(69,302)
	Electric Vehicles	(59,774)
32	Develop and expand local electric vehicle market	
33	Convert taxi fleet to electric vehicles	
34	Convert service delivery vehicles to electric vehicles	
35	**Urban Forest: 700,000 additional trees**	(15,594)
Total savings over business as usual		(2,060,388)

	State Actions	Additional Savings Anticipated from State Actions
A.	**Renewables Portfolio Standard**	(279,496)
B.	**Pavley Auto Fuel Economy Standards**	(890,495)

Municipal Operations

As of 2010 just under 4% of San Francisco's GHG emissions were generated by energy consumed in municipal government buildings and fleet vehicles, including health services (San Francisco General Hospital and neighborhood clinics), safety and emergency services (police, fire protection, and emergency entities), public works maintenance (roadways and parks), airport and port operations, parks and recreation, and Muni buses and light rail. Between 1990 and 2010 the city government reduced emissions in these areas by 25,870 mT CO_2e.[3]

GHG emissions reductions at the municipal level have come from the clean electricity provided by Hetch Hetchy Power being used in buildings. Emissions are projected to fall even further as the San Francisco Public Utilities Commission began providing 100% carbon-free electricity to all municipal buildings in Fiscal Years 2011–2012. Natural gas use for heating in buildings increased from 1990 to 2010, causing an increase in associated emissions. Total diesel consumption increased across the city fleet, but emissions from diesel were down due to the introduction of more efficient buses and hybrid models, and the increased use of biodiesel fuel blends. Overall emissions from municipal energy use and Muni fuel have declined since 1990.

In 2005 the City and County of San Francisco began voluntarily reporting our operational carbon footprint to the California Climate Action Registry. In 2008, at the direction of the Board of Supervisors Ordinance 81-08, the City took an even more detailed inventory of our emissions, bringing carbon accounting down to the department level. Reporting to California Climate Action Registry was ceased due to the more detailed level of accounting required by Ordinance 81-08.

Endnotes

[1] California Energy Commission, Climate Change Impacts, Vulnerabilities, and Adaptation in the San Francisco Bay Area: A Synthesis of PIER Program Reports and Other Relevant Research, July 2012.

[2] U.N. Habitat, Cities and Climate Change: Global Report on Human Settlements, March 2011.

[3] San Francisco 2010 Community-Wide GHG Inventory, City and County of San Francisco. San Francisco Department of the Environment Climate Team. 3rd Party Verified, ICF International, April 10, 2012.

1 Local Climate Impacts

Despite the city's progress in reducing greenhouse gas (GHG) emissions, San Francisco must face the reality that climate change is already happening. Sea level rise, a reduced snowpack in the Sierra Nevada mountains, and extreme weather events are some of the challenges already affecting the Bay Area.[1] A recent scientific projection shows sea level increasing 11 to 19 inches by 2050 and 30 to 55 inches by 2100.[2]

Runways at San Francisco International Airport, primary arteries such as Highway 101, neighborhoods, businesses, and miles of shoreline and parks eventually could be underwater. This could result in an estimated $62 billion worth of infrastructure damage in the greater Bay Area.[3] By mid-century, San Franciscans could see three to four times as many extreme heat days as occurred in 2010, with related increases in hospitalizations and deaths, especially for vulnerable population groups—seniors, young children, and those living in low-income neighborhoods.[4] It is critical for all citizens to gain a deeper understanding of these potential environmental and health impacts and prepare to adapt. In short, climate adaptation has emerged as a priority challenge for San Francisco.

Potential Impacts

Sea Level Rise and Flooding

Over the past century, the mean sea level has risen on the California coast by almost 8 inches. Global warming is causing thermal expansion in the oceans and melting the polar ice caps. Under anticipated GHG emission scenarios, this will cause the sea to rise an additional 11 to 19 inches by 2050 and as much as 30 to 55 inches by the end of the century. Sea level rise will increase the likelihood and intensity of flooding in San Francisco and will expose new areas to flooding. Under current projections, San Francisco is likely to experience more frequent storm surges, flooding during high tides, and rapidly increasing shoreline erosion. Table 3 shows the people and property at risk from sea-level-rise-related flooding in San Francisco Bay and the Bay Area per the California Energy Commission.

The Embarcadero waterfront is already experiencing flooding during king tide events.

Photo: ©Dave F

Projected sea level rise in San Francisco

2100 30–55 inches

2050 11–19 inches

Table 3. **People and Property at Risk from Sea-Level-Rise (SLR)-Related Flooding (California Energy Commission)**

	Current	1.0 m SLR	1.4 m SLR
SF Bay Area Flooding Risk (people)	140,000	220,000	270,000
SF Flooding Risk (people)	190	1,600	3,800
SF Transportation (roads in miles)	3.4	29	53
SF Bay Area Property ($)	$29 billion	$49 billion	$62 billion
SF Property ($)	$110 million	$1.4 billion	$4.0 billion

Climate scenarios prepared for the California Energy Commission project that storms will be shorter and more intense. Coupled with increased frequency of high tide storm events, the city's coastal infrastructure will be particularly vulnerable. Projections show an 11% increase in the intensity of rainstorms by the end of the century.[5] Future flooding could hinder access to roads and the areas of the city that are affected, hampering emergency response and jeopardizing human lives. Moreover, much of the infrastructure at risk from sea level rise in San Francisco is located in the parts of the city that are susceptible to liquefaction from earthquakes.

Despite the forecasted increase in intensity of rainstorms, projections show that future annual precipitation in northern California will not change much. The greatest reduction in precipitation is expected to occur in the spring, whereas the main precipitation months (during the winter) will remain relatively unchanged.[6]

Temperature Rise and Heat Waves

An average increase of 2.7° Fahrenheit (F) by 2050 in the Bay Area is likely to result just from the GHGs put into the atmosphere during the last century. By 2100, temperature increases of 3.6 to 10.8°F are projected. More warming will occur in the summer than the winter.

The San Francisco Department of Public Health has recently released a study under the US Center for Disease Control that assesses the heat risk posed by increasing temperatures to San Franciscans. Climate models used for this study predict extreme heat events will increase in severity and frequency in San Francisco, with a projected 39 extreme heat events by 2050. Our city will face more dangerously hot days and deadly health outcomes, especially for our vulnerable populations.[7]

Simulations of the impact on the Bay Area show a more than threefold increase in the frequency of hot days and a decided increase in intensity of hot days as well, with an increasing tendency for multiple hot days in succession—heat waves that last longer.

San Franciscans are particularly vulnerable to extreme heat events. Physiologically, any sudden change in temperature will affect how the human body thermoregulates. Because residents do not regularly experience high temperatures for extended durations, they can be expected to have a more difficult time physically with heat (compared to those in Livermore for example, where an extreme heat day may be over 98°F but residents are accustomed to such temperatures). This extreme heat may cause added heat stress and increased risk of heat-related illness for San Francisco inhabitants. In addition, the city's housing is less likely to have central air conditioning, because of the age of the housing stock and the historically cooler climate.[8]

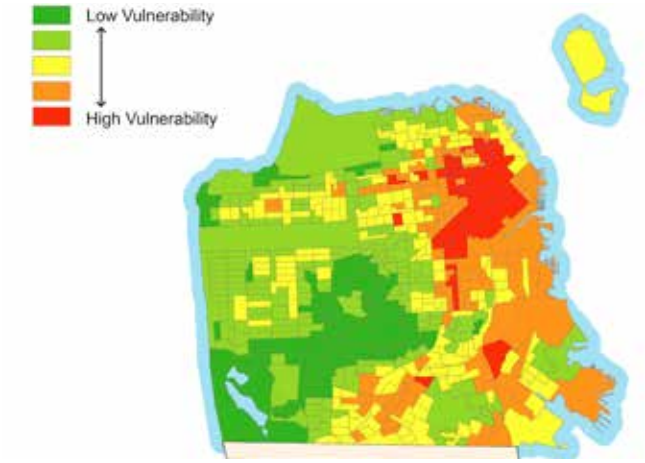
The demographic characteristics that make certain groups most vulnerable to heat-related illness in San Francisco include age (the very young and the very old), race, income, social isolation, access to top-floor living spaces, and access to air conditioning or other cooling.[9]

Certain San Francisco neighborhoods have substantially higher risks during an extreme heat event than others because of their landscape and buildings, and the age, socioeconomic status, and social isolation of their residents. These neighborhoods include Chinatown, Downtown Civic Center, Bayview, Outer Mission, South of Market, the Tenderloin, and Western Addition. The Department of Public Health in coordination with other City agencies and public groups will continue to assess climate trends, define disease burden, evaluate effects of change for at-risk populations, and work to promote community resilience through education, empowerment, and engagement to reduce the health impacts to climate change.

San Francisco property at risk in 2100

$4 billion

Figure 2. **Heat Vulnerability Index by Census Block Group, San Francisco**



San Francisco Department of Public Health (2012). Developing Public Health Capacity and Adaptations to Reduce Human Health Effects of Climate Change. Unpublished data.

Water Supply

San Franciscans enjoy excellent drinking water from the Hetch Hetchy Water System. Risks to the water supply come from the changing pattern of snowfall and overall precipitation in the Sierra Nevada mountain range. Increasingly, snow is falling at different times of the year, and more precipitation is coming as rain instead of snow. Snowmelt is happening 5 to 30 days earlier than historically observed.[10] To protect the city's water from supply disruptions caused by climate change, the San Francisco Public Utilities Commission (SFPUC) is exploring new local water sources as well as ways to encourage homes and businesses to conserve water.

Wastewater Management

By mid-century, sea level rise plus increased tidal extremes and storms are expected to affect San Francisco's wastewater system. A number of pump stations, facilities, and outfalls to the bay are projected to be inundated, thereby suffering from saltwater intrusion and backflow issues. Localized flooding from extreme rain events could lead to operational interruptions, street flooding, and more frequent releases of polluted water into the bay if the combined sewer system (which conveys wastewater and stormwater in the same system) is overwhelmed.

The SFPUC Wastewater Enterprise Sewer System Improvement Program has added sea level rise projections in its planning efforts to protect the system. In 2011, the City started upgrading outflow pipes in the wastewater system, to guard against sea-level-rise-related backflow. Over the longer term, the SFPUC is developing strategies to accommodate expected sea level rise and increased flooding, especially as the Commission plans new or upgrades existing wastewater treatment facilities.

Energy Infrastructure

Although energy demand is unlikely to significantly increase as a result of climate change within San Francisco itself, demand in other areas of the Bay and the state could have an indirect effect on the City if the grid is overloaded during extreme heat days. Energy supply could also be affected by changes in snowmelt patterns in the Sierra Nevada Mountains, affecting the hydroelectric power that contributes to San Francisco's electricity supply. Furthermore, energy transmission could be affected by sea level rise, flooding, wildfires (especially outside the Bay Area), and increased temperatures adversely affecting power lines, substations, and power stations. Any of these impacts can cause outages or service disruptions in San Francisco.

Transportation Infrastructure

Major components of the transportation network that serves San Francisco and the Bay Area are at risk from sea level rise and periodic inundation from storm surge or heavy rain by mid-century. These include local streets, freeways, bridge approaches, rail and Bay Area Rapid Transit (BART) lines, the San Francisco Port, and the Oakland and San Francisco International Airports. The Embarcadero BART station and many of the municipal bus routes are known to be at risk from sea level rise. An estimated 80% of the Port of San Francisco could be inundated by the end of the century under a 55-inch sea level rise scenario.[11]

The temporary or permanent inundation of these assets would have a tremendous economic impact on the Bay Area because commuter and goods movement would be disrupted. This scenario also would pose public health threats if lifeline and emergency access routes were compromised.

Photo: Adam Soto

Ecosystems

Changing weather patterns are shifting our regional ecosystem, from being populated by forests to featuring more shrub-dominated landscapes. Coastal redwoods are particularly sensitive because of their need for cool and regular temperatures and their dependence on fog for moisture. Tidal marshes are unable to migrate, and they will suffer the greatest losses in habitat and diversity. Ecosystems rely on regular weather and sea temperature patterns, such as seasonal upwelling that brings nutrients to the surface and feeds the fish and sea life populations just off San Francisco's shores. Native species are particularly vulnerable. Conservation strategies will have to be developed in partnership with others on a regional level. Future areas of focus by the Department of the Environment will seek to broaden our understanding and care of natural systems within and around San Francisco, especially urban wildlife corridors and ocean health. Better identification of the value of maintaining and expanding these spaces to offset the effects of climate change is a key area of further exploration and research.

Climate Change Variability

Climate science and our understanding of the likely changes and impacts are continually evolving, and thus the predictions outlined in this discussion need to be revisited on a regular basis. The California Climate Change Center, a division of the California Energy Commission, prepares periodic reports on the science of climate change and the impacts of climate change on California's economy. The Center has conducted three assessments, and the latest one was released in July 2012. Each assessment highlights the major findings and implications of climate change for the state, based on a collection of scientific studies from academic institutions and state agencies. The Center's third assessment included over 30 peer-reviewed papers from the University of California and other research organizations. The California Energy Commission is currently developing a significant number of studies analyzing more ways to precisely estimate climate impacts in the Bay Area.

Photo © Laura Sasso

Adaptation Planning

Many City agencies have already begun planning for climate change. In order to collaborate across the city family and with our private sector partners, the Department of the Environment and the Office of the City Administrator convened an interdepartmental working group, AdaptSF, at the end of 2012.

Three key components of AdaptSF planning already are complete:

- a study on sea level rise impacts on Port property, the Port of San Francisco
- reviews of potential water supply impacts, SFPUC
- an assessment of public health impacts from high heat, the San Francisco Department of Public Health

The group's next steps are as follows:

- integrating sea level rise and energy assurance planning into San Francisco's Capital Planning and Hazard Mitigation plans
- communicating public health impacts to San Franciscans
- completing Mission Bay Islais Creek development adaptation study, SF Port and Bay Conservation and Development Commission
- communicating flood risk and opportunities for home owners to invest in flood insurance, City Administrator
- evaluating San Francisco's sea wall and impacts of sea level rise on the Embarcadero and Financial District
- evaluating potential sea level rise climate change impacts on San Francisco International Airport
- developing a plan for transit impacts, being prepared by the San Francisco Municipal Transportation Agency

Adapt SF is the coordinating group for the body of work that encompasses adaptation. The goals of the working group are to build interdepartmental coordination and collaboration in order to address these risks, increase private sector and community awareness and capacity to respond to emergencies, and integrate climate impact considerations and parameters into all City capital investments, plans, codes, and standards.

Endnotes

[1] Regional and Local Increases in Storm Intensity in the San Francisco Bay Area, USA between 1890 and 2010. Tess A. Russo, Andrew T. Fisher, Dustin M. Winslow, University of Santa Cruz. Published online: 19 APR 2013 DOI: 10.1002/jgrd.50225 ©2013. American Geophysical Union. All Rights Reserved.

[2] National Research Council, Sea-Level Rise for the Coasts of California, Oregon, and Washington: Past, Present, and Future, June 2012.

[3] California Energy Commission, Climate Change Impacts, Vulnerabilities, and Adaptation in the San Francisco Bay Area: A Synthesis of PIER Program Reports and Other Relevant Research, July 2012.

[4] California Energy Commission, Climate Change Impacts, Vulnerabilities, and Adaptation in the San Francisco Bay Area: A Synthesis of PIER Program Reports and Other Relevant Research, July 2012.

[5] Dettinger, "Climate change, atmospheric rivers, and floods in California—a multimodal analysis of storm frequency and magnitude changes, "Journal of the American Water Resources Association (JAWRA) 47 (3): 514–523, 2011.

[6] D.R. Cayan, M. Tyree, D. Pierce, and T. Das, Climate Change and Sea Level Rise Scenarios for California Vulnerability and Adaptation Assessment, California Energy Commission, publication number: CEC-500-2012-008, 2012.

[7] San Francisco Department of Public Health, Climate Change and Public Health. Environmental Health Assessment of Vulnerability to Extreme Heat Events and Air Quality, 2011.

[8] Jerrett, J. G. Su, C. E. Reid, B. Jesdale, A. M. Ortega Hinojosa, S. B. Shonkoff, E. Seto, and R. Morello-Frosch, Mapping Climate Change Exposures, Vulnerabilities, and Adaptation to Public Health Risks in the San Francisco Bay and Fresno Regions, California Energy Commission, publication number: CEC-500-2012-041, 2012.

[9] M. Jerrett, J. G. Su, C. E. Reid, B. Jesdale, A. M. Ortega Hinojosa, S. B. Shonkoff, E. Seto, and R. Morello-Frosch, Mapping Climate Change Exposures, Vulnerabilities, and Adaptation to Public Health Risks in the San Francisco Bay and Fresno Regions, California Energy Commission, publication number: CEC-500-2012-041, 2012.

[10] Iris T. Stewart, Daniel R. Cayan, Michael D. Dettinger, "Changes toward Earlier Streamflow Timing across Western North America," J. Climate, 18, 1136–1155, 2005.

[11] Biging, Radke, and Lee, Impacts of Predicted Sea-Level rise and Extreme Storm Events on the Transportation Infrastructure in the San Francisco Bay Region, California Energy Commission, 2012.

Photo: ©Laura Sass

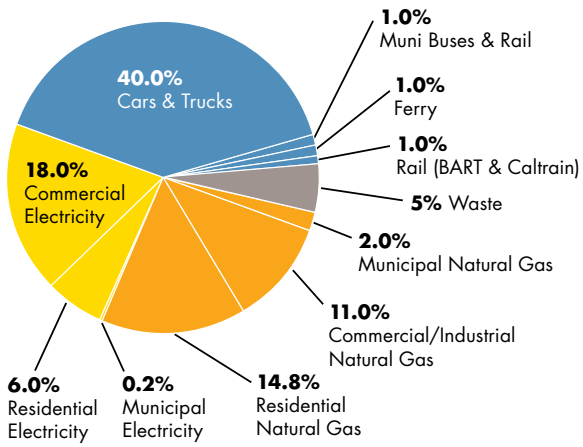
2 GHG Emissions Inventory

In 2012, San Francisco completed a community-wide inventory of greenhouse gas (GHG) emissions for 2010. Having an accurate inventory and conducting annual updates helps the City focus efforts on reducing the largest sources of GHG emissions while tracking progress.

In 2010, GHG emissions totaled 5.3 million metric tons (mT), a reduction of 14.5% below 1990 levels (see Table 5). The buildings sector was the largest emissions source at 52%, with 28% coming from natural gas use for heating and cooling, and 24% from electricity use. The transportation sector contributed 43%, almost all of which came from cars and trucks. The waste sector (for waste sent to landfills that produces methane during decomposition) contributed the remaining 5% of emissions. The inventory has been independently verified.[1]

Between 1990 and 2010 the community of San Francisco successfully reduced its carbon footprint by 14.5%. This reduction in GHG emissions was achieved even though San Francisco's population increased 11% in the same time period. This growth in population, coupled with the decrease

Figure 3. **San Francisco GHG Emissions, 2010 Inventory**



Total footprint: 5.3 million metric tons CO_2e (14.5% below 1990)

Table 4. **San Francisco GHG Emissions, 2010 Inventory**

Source	CO_2e (mT)	%
Cars & Trucks	2,118,863	40.0
Commercial Electricity	928,785	18.0
Residential Natural Gas	782,960	14.8
Commercial Natural Gas	609,521	11.0
Waste	244,625	5.0
Residential Electricity	335,195	6.0
Municipal Electricity	12,489	0.2
Municipal Natural Gas	119,860	2.0
Rail (BART & Caltrain)	68,046	1.0
Ferry	34,103	1.0
Muni	45,310	1.0
TOTAL	**5,299,757**	**100.0**
Forestry (sink)	(4,717)	-0.1
TOTAL with Sink	5,295,040	

Photo©Laura Sasso

San Francisco's increasing population

805,000 2010 population

729,000 1990 population

in community-wide GHG emissions, gave San Francisco an annual per capita total of 6.5 mT in 2010, compared with 9.0 mT in 1990, a 28% per capita decline. The main drivers of the GHG emissions reduction can be attributed to the following:

- closure of two dirty and inefficient natural gas and diesel power plants, at Hunters Point (in 2006) and Potrero (reduced output 2010, decommissioned Jan 2011), and replacement with increased transmission capacity electricity produced by cleaner fuel sources and more efficient power plants;
- an 80% diversion of the waste stream from landfills through recycling or composting; and
- fluctuations in the economy, improvements in federal and California appliance and energy standards as well as the implementation of progressive energy efficiency and green building standards in San Francisco, which mitigated growth in electricity demand and lowered natural gas use in the residential sector.

Figure 4. **San Francisco Emissions Decline with Cleaner Electricity and Waste Recycling**

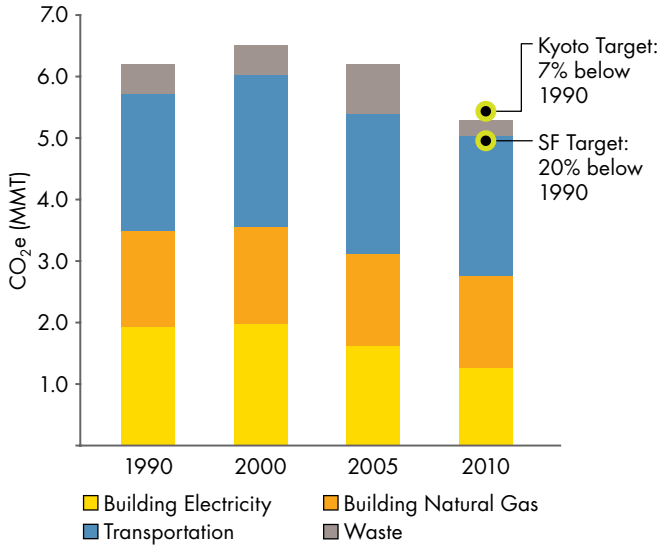


Photo: ©Laura Sasso

The Inventory Methodology

GHG inventory methodologies have developed substantially since the first San Francisco community-wide inventory was compiled in 2004. For the 2010 update, the City followed guidance from the California Office of Planning and Research, California Environmental Quality Act Guidelines Section 15183.5, and a preliminary draft of the U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions, developed by ICLEI and published in 2012.[2] The 2010 inventory included GHG emissions from the following:

- buildings: electricity and natural gas uses in commercial, residential, and municipal sectors
- cars and trucks: vehicle miles traveled (VMT), from in-city and inbound commuter trips
- regional transit agencies: biodiesel, diesel, and electricity consumed by Bay Area Rapid Transit (BART), Caltrain, and Golden Gate buses and ferries
- Muni fleet: diesel and electricity consumed by buses
- landfills: commercial, residential and municipal waste sent to landfills that generated methane gas
- urban forest sink: tons of emissions sequestered by trees in San Francisco

How does this differ from previous inventories?

Interregional road travel: At the direction of the Metropolitan Transportation Commission, the 2010 inventory did not count pass-through trips and only counted half of commuter trip VMT; the other half were attributed to the city of origin.

Landfill emissions: At the direction of the Bay Area Air Quality Management District, the 2010 inventory included GHG emissions generated by waste produced in San Francisco and sent to landfills outside city limits.

Electricity emissions factors: The fuels used to generate grid electricity dictate its emissions factor or carbon intensity. For example electricity that is predominately generated from coal will have a higher carbon intensity than that generated from a mixture of gas and renewable energy sources. For the 2010 inventory, the City was able to assign the specific carbon intensity associated with electricity from different energy suppliers instead of the weighted average electricity emissions factor that was used previously.

This change increases the accuracy in assigning emissions responsibility. Previously the level of data on energy consumption and carbon intensity for electricity was not available. The 1990 baseline and subsequent inventory years have been recalculated, in line with these changes, so that the GHG emissions reduction from each year can be compared. Each inventory has been independently verified.

Why are no greenhouse gas emissions associated with water and wastewater in San Francisco?

While water provision and water consumption are responsible for 19% of the energy used statewide, the energy water nexus is different for San Francisco. Carbon impacts associated with water delivery are uniquely low in San Francisco because of the Hetch Hetchy water delivery system, which is predominantly gravity fed and therefore requires significantly less energy for pumping and distribution. In addition, the carbon footprint of the electricity that is used for pumping between storage reservoirs and into the city is very low due to the San Francisco Public Utilities Commission's (SFPUC) low-carbon electricity. In the long term, some GHG emission reductions are expected in the buildings sector from water conservation measures due to an anticipated reduction in natural gas use from water heating efficiency measures.

Similar to water provision, very low-carbon emissions are associated with wastewater treatment since all power used in the process is also provided by the SFPUC. Total process and fugitive emissions from San Francisco's waste water treatment plants are under the limit required for mandatory reporting by the state. All emissions associated with water use and treatment are grouped under the SFPUC municipal operations.

What sources are not included in the Community-Wide GHG Inventory?

Emissions from air travel: These emissions are not included in official Community-Wide GHG Inventories. However, they were included in the City's 2008 Trans-Boundary Infrastructure Footprint GHG Inventory discussed in Chapter 5 Zero Waste (page 40).[3]

Emissions from goods movement and other heavy duty commercial fleets: Although emissions from these sources could be significant and will be especially important to target in order to address local health impacts associated with criteria pollutants from fossil fuels burned in vehicles, inadequate data was available for inclusion in the 2010 inventory. Plans are in place to improve the data for inclusion in future inventories.

Fugitive emissions: While the City does not currently account for fugitive emissions, natural gas leaks from Pacific Gas and Electric's (PG&E) distribution system are a potentially significant source of GHG emissions in San Francisco. Leaks can occur at pipeline distribution hubs or at connection points where natural gas enters homes or other buildings. New studies by the U.S. Environmental Protection Agency and Environmental Defense Fund point to much greater leakage from natural gas infrastructure than previously assumed. Because methane, the main component of natural gas, has a global warming potential 72 times greater than carbon dioxide (CO_2) over a 20-year period, even small amounts of methane can contribute significantly to climate change.[4]

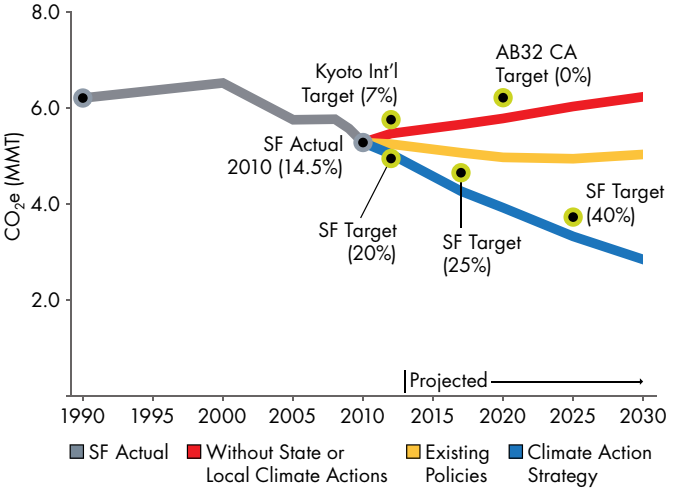
The potential warming impacts of methane leaking from our natural gas distribution system is significant, yet the magnitude of the problem has not been adequately studied. There is currently no accurate method to estimate the amount of fugitive emissions that may be leaking from San Francisco's natural gas distribution system. The political climate surrounding safety concerns and the large costs of leak detection and pipeline repair make this is a sensitive area for investigation. Simultaneously, there are regulatory gaps in the course and process of natural gas distribution and good data regarding total mined, delivered, leaked and consumed natural gas is lacking.

In order to discover the magnitude of the climate impact leaking methane may have, policy makers will need to overcome several barriers: lack of accurate information about leakage, seeing leakage as an acceptable and reasonable part of doing business, lack of financial incentive for utilities to fix non-hazardous leaks, and higher costs. The City of San Francisco calls upon the California Air Resources Board to require better leakage studies and to account for the true environmental cost of leaked methane under Assembly Bill 32's Cap-and-Trade program. The San Francisco Department of the Environment (SF Environment), PG&E, the California Public Utilities Commission, and other stakeholders will work together and conduct a leakage study of San Francisco using a vehicle-mounted methane analyzer device, as has been done in Boston and New York City.

Potential Greenhouse Gas Emissions Reductions

For the 2013 Climate Action Strategy Update, SF Environment has partnered with the San Francisco Municipal Transportation Agency (SFMTA), the San Francisco County Transportation Authority, and SFPUC to identify and quantify which climate actions in their strategic plans have the most impact. After two years of development, taking into consideration SFMTA's Community Climate Action Strategy, the San Francisco Electricity Resources Plan, and strategic plans from the Green Building, Zero Waste, Energy Efficiency and Urban Forest teams at SF Environment, 35 actions were chosen to project future GHG emissions scenarios in San Francisco. Each one of the selected actions also was vetted through a public participation process. To show San Francisco's potential future GHG emissions path, three scenarios were envisioned. All three scenarios assume projected population growth from the Association of Bay Area Governments, regional jobs and housing allocation from the Metropolitan Transportation Commission, and energy demand forecasts from the California Energy Commission.

Figure 5. **San Francisco GHG Emissions On Track to Beat Upcoming International and State Targets**

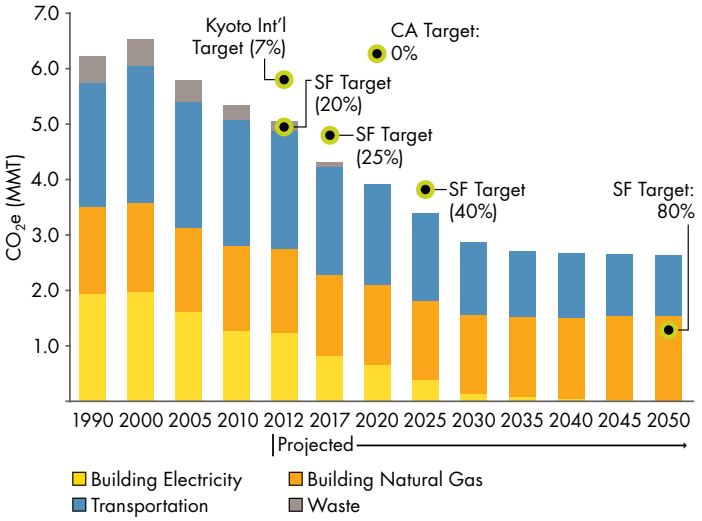


Percentages illustrate the percentage below 1990 levels.

- **No action:** This scenario estimates San Francisco's GHG emissions path if key climate policies at the state and local level were stopped as of 2010. It highlights the critical importance of the California Clean Car Standards (which will require passenger cars and light trucks manufactured in model years 2012 through 2016 to meet an estimated combined average 34.1 miles per gallon by 2016) and the state's Renewables Portfolio Standard in reducing emissions at the local level. Without these programs and other existing local polices that reduce energy use and reduce traffic, GHG emissions will rise with population increase and economic activity.
- **Existing state and local policies:** This projection includes impacts from existing state policies, specifically the Renewables Portfolio Standard and California Clean Car Standards, as well as impacts from the continuation of existing local policies, such as local green building codes and existing energy efficiency programs. This strategy is often called the "business as usual" scenario.
- **2013 Climate Action Strategy:** This projection estimates the emissions reduction potential from 35 climate actions, including the ones listed in the business as usual scenario.

In all scenarios San Francisco remains on track to meet the Assembly Bill 32 goals of 1990 emissions level by 2020. The 2013 Climate Action Strategy puts San Francisco on a path to meet the City's GHG emissions reduction targets of 25% below 1990 levels by 2017, and 40% below 1990 levels by 2025. Additional actions beyond those outlined here will be needed to meet the goal of an 80% reduction below 1990 levels by 2050.

Figure 6. **San Francisco's GHG Emissions under the CAS to 2050**



What greenhouse gas emissions reductions can San Francisco achieve by 2030?

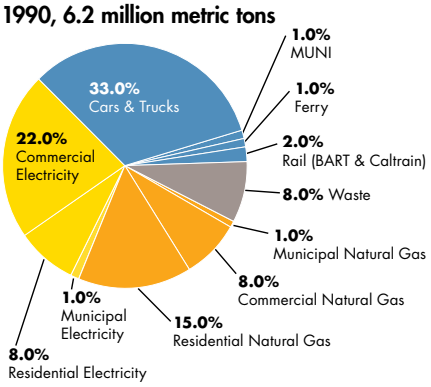
If the plans and policies described in the 2013 Climate Action Strategy are implemented, by 2030 San Francisco's GHG emissions will be 52% below 1990 levels (see Table 5), achieving the targets set by the San Francisco Board of Supervisors. Specifically, these goals will be achieved by

- sourcing **100%** of residential and 80% of commercial electricity from renewable sources, coupled with energy efficiency improvements to reduce usage;
- reducing natural gas use through energy efficiency improvements;
- making **50%** of all trips outside of personal vehicles; and
- achieving San Francisco's **0** waste goal (reducing emissions from this sector to zero).

Should each of these goals be achieved San Francisco's carbon footprint will not only be much lower, it will look substantially different with natural gas contributing 48%, cars and trucks contributing 45%, electricity use in buildings contributing 6%, and other transportation (BART, Caltrain, and ferry) making up the remaining 1% in 2030. Future climate action strategies will have to continue to address transportation emissions, and natural gas usage and leakage.

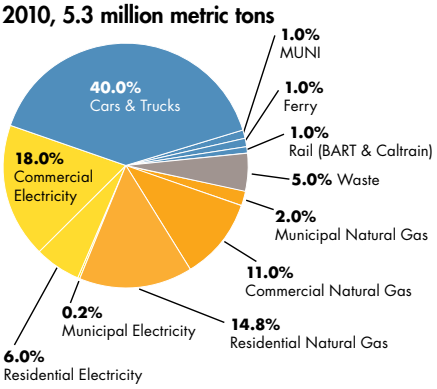
Figure 7. **San Francisco's CO_2e Emissions Projections: 1990, 2010, 2030**

1990, 6.2 million metric tons



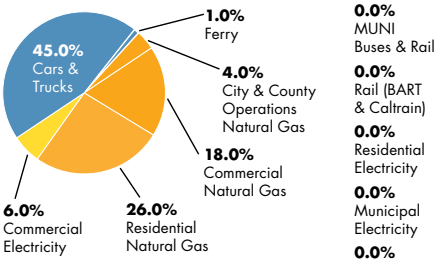
Source	CO_2e (mT)
Cars & Trucks	2,037,736
Residential Natural Gas	939,683
Commercial Electricity	1,378,706
Commercial Natural Gas	522,205
Residential Electricity	509,906
Waste	472,646
Municipal Electricity	50,402
Municipal Natural Gas	96,360
Rail (BART & Caltrain)	97,546
Ferry	39,991
MUNI	56,767
Forestry (sink)	(unknown)
TOTAL	6,201,949

2010, 5.3 million metric tons



Source	CO_2e (mT)
Cars & Trucks	2,118,863
Residential Natural Gas	782,960
Commercial Electricity	928,785
Commercial Natural Gas	609,521
Residential Electricity	335,195
Waste	244,625
Municipal Electricity	12,489
Municipal Natural Gas	119,860
Rail (BART & Caltrain)	68,046
Ferry	34,103
MUNI	45,310
Forestry (sink)	(4,717)
TOTAL	5,299,757
TOTAL with Sink	5,295,040

2030, 2.9 million metric tons



Source	CO_2e (mT)
Cars & Trucks	1,331,999
Residential Natural Gas	791,238
Commercial Electricity	168,474
Commercial Natural Gas	524,595
Residential Electricity	0
Waste	---
Municipal Electricity	0
Municipal Natural Gas	120,975
Rail (BART & Caltrain)	13,560
Ferry	38,429
MUNI	0
Forestry (sink)	(20,311)
TOTAL	2,989,271
TOTAL with Sink	2,968,960

Endnotes:

[1] ICF International, Technical Review of the 2010 Community-wide GHG Inventory for the City and County of San Francisco, April 2012.

[2] ICLEI–Local Governments for Sustainability USA, U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions, Version 1.0, October 2012.

[3] SF Environment and University of Denver, Colorado Center for Sustainable Infrastructure Systems, San Francisco Trans-Boundary Infrastructure Footprint, Executive Summary, February 2012.

[4] Climate Change 2007- The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the IPCC.

Table 5. **San Francisco Community-Wide Carbon Emissions Inventory**

	1990	2000	2005	2010	Change from 1990
Consumption					
Electricity	5,373,674	6,173,681	5,892,999	6,090,392	13.3%
MWh - Residential	1,174,168	1,458,761	1,362,559	1,418,110	20.8%
MWh - Commercial	3,174,768	2,965,106	2,846,818	3,053,806	-3.8%
MWh - Municipal	765,328	938,133	828,601	849,805	11.0%
MWh - BART	206,254	268,130	281,022	304,121	47.5%
MWh - Muni	53,156	95,047	95,047	100,659	89.4%
MWh - Other (Direct Access)	0	448,503	478,952	363,892	
Natural Gas	292,818,411	299,394,981	281,166,055	285,042,135	-2.7%
Therms - Residential	176,580,538	155,025,499	143,120,463	147,570,333	-16.4%
Therms - Commercial	98,130,284	120,256,450	115,470,958	114,880,962	17.1%
Therms - Municipal	18,107,589	24,113,033	22,574,634	22,590,840	24.8%
Fuel	5,216,833	5,267,362	5,111,293	4,292,751	-17.7%
Diesel - Muni (gal)	5,216,833	5,267,362	5,111,293	4,292,751	-17.7%
Diesel - Caltrain + Ferry (gal)	4,725,835	10,690,071	9,987,776	4,545,532	-3.8%
VMT	3,648,000,000	3,880,000,000	3,777,853,741	3,910,784,576	7.2%
Waste (mT)	667,000	872,731	664,033	444,398	-33.4%
Biofuel (B100) Consumption (gal)				420,708	
Emission Factors					
Community Electricity (PG&E and Power Plants) (lbs/MWh)	957.40	874.50	675.20	521.10	-45.6%
Natural Gas* (lbs/therm)	11.7	11.7	11.7	11.7	-0.3%
VMT (g/VMT)	558.59	568.53	543.65	541.80	-3.0%
Diesel - Caltrain & Ferry (lbs/gal)	22.38	22.38	22.38	22.38	0.0%
Diesel - Muni (lbs/gal)	22.51	22.51	22.51	22.51	0.0%
Waste** (lbs/MT)	1,562.23	1,213.56	1,213.56	1,213.56	-22.3%
Hetch Hetchy Power (lbs/MWh)	145.19	149.57	151.30	32.40	-77.7%
Direct Access - Other	957.40	748.50	1,284.76	1,253.89	31.0%
Direct Access - BART	957.40	748.50	444.48	406.04	-57.6%
Emissions					
Electricity	2,032,085	2,068,204	1,688,349	1,333,959	-34.4%
MWh - Residential	509,906	578,642	417,305	335,195	-34.3%
MWh - Commercial	1,378,706	1,176,160	871,883	721,820	-47.6%
MWh - Municipal	50,402	63,647	56,866	12,489	-75.2%
MWh - BART	89,570	91,034	56,658	56,012	-37.5%
MWh - Muni	3,501	6,448	6,523	1,479	-57.7%
MWh - Other (Direct Access)	-	152,273	279,114	206,965	
Natural Gas	1,558,248	1,593,246	1,496,240	1,512,341	-2.9%
Therms - Residential	939,683	824,976	761,623	782,960	-16.7%
Therms - Commercial	522,205	639,951	614,485	609,521	16.7%
Therms - Municipal	96,360	128,319	120,132	119,860	24.4%
Fuel	101,233	162,286	153,565	89,968	-11.1%
Diesel - Muni	53,266	53,782	52,188	43,831	-17.7%
Caltrain + Ferry	47,967	108,505	101,376	46,137	-3.8%
VMT	2,037,736	2,205,904	2,053,823	2,118,863	4.0%
Waste	472,646	480,407	365,526	244,625	-48.2%
Total Emissions (mT CO_2e)	6,201,949	6,510,048	5,757,502	5,299,757	-14.5%
Biogenic Emissions (not included in total)				3,975	

*Natural Gas emissions factor changed from 11.732 to 11.697 lbs CO_2/therm for 2008 emissions calculations

**Weighted average emissions by waste type.

3 Energy Use in Buildings

Contribution to Greenhouse Gas Emissions

Just over half (52%) of San Francisco's greenhouse gas (GHG) emissions come from energy used in the city's 197,000 residential and commercial buildings. Carbon dioxide (CO_2) is one of several pollutants that result from coal and natural gas being burned to generate electricity at power plants and in homes and offices for heating. The City's efforts to reduce these emissions focus on using less energy, improved efficiency, and energy recovery as well as on de-carbonizing the energy supply by replacing fossil fuels sources with renewable energy sources—micro-hydro, wind, geothermal, solar, wave, and biomass.

Trends since 1990

San Francisco's combined GHG emissions from electricity and natural gas dropped from 3.5 million metric tons (MMT) in 1990 to 2.8 MMT in 2010. Shifts to cleaner energy in San Francisco and in California have caused this downward emissions trend.

Electricity Trends

Between 1990 and 2010, electricity consumption in San Francisco increased 11%, roughly in line with the city's population growth over the same period. This trend in increased consumption of electricity points to the emerging trend of increased plug loads and consumption from servers and electronic data storage. However, while consumption increased, resources used to generate electricity have become cleaner so overall emissions resulting from electricity

Emissions from electricity used in buildings decreased

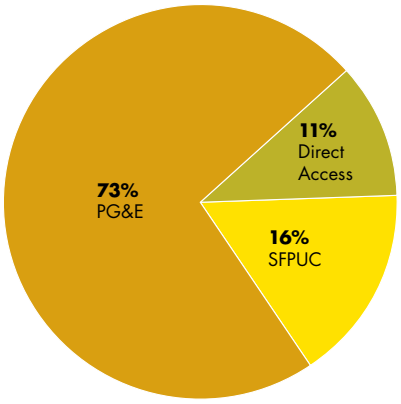
1990

2010 ↓

708,453 mT CO_2e

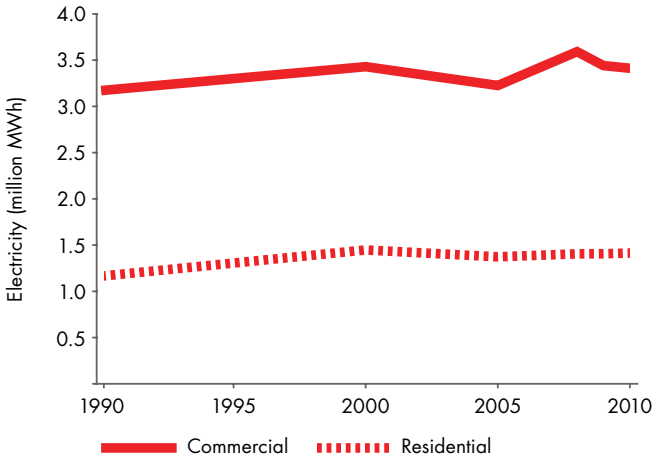
use in buildings were lower in 2010 than in 1990 by 34.2%. Working with community groups, Pacific Gas and Electric (PG&E), the California Independent System Operator, and the California Public Utilities Commission, the City of San Francisco won a major environmental justice victory when two of the oldest, most inefficient and dirtiest gas-fired power plants in the state were closed (Hunters Point in 2006, and Potrero in 2010). The closure of these plants decreased the carbon intensity of the electricity grid systemwide. In the case of the Potrero power plant, it was decommissioned over time and significantly reduced its output during 2010. Furthermore, PG&E's compliance with California's Renewable Portfolio Standard (RPS) is delivering a growing percentage of electricity from renewable sources. By 2010, the percentage of PG&E's power supply from RPS-eligible, renewable electricity reached 15.9%.

Figure 8. **San Francisco Electricity Supply by Provider 2010**



Total Electricity Use: 6.1 million MWh
Data sources: PG&E and SFPUC

Figure 9. **Electricity Use in San Francisco, 1990–2010**



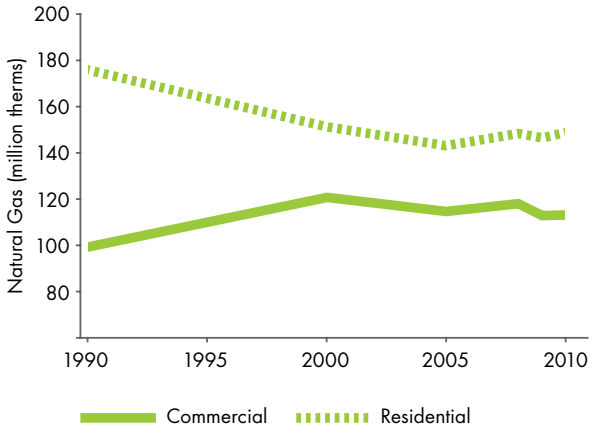
Currently, 73% of the electricity used in San Francisco comes from PG&E and 16% from the San Francisco Public Utilities Commission's (SFPUC). The remaining 11% comes from independently contracted energy service providers used by some large commercial and industrial customers such as the Bay Area Rapid Transit district.

An impressive 41% of the combined electricity mix for San Francisco (PG&E, SFPUC, and energy service providers) came from renewable sources in 2010. SFPUC's system supplies electricity for the city's municipal buildings, and services including the Muni's electrified buses and rail cars, and San Francisco International Airport. SFPUC's power was nearly carbon free in 2010 and is 100% renewable as of 2012.

Natural Gas Trends

Natural gas is used for heating, hot water, cooking, industrial activity, and some in-city electricity and steam production in San Francisco. From 1990 to 2010, natural gas consumption in the city decreased by almost 3%, despite a 4% increase in heating degree-days during the same period. This decrease in consumption came entirely from the residential sector while consumption of natural gas by the municipal government and the business sector increased. California building and appliance efficiency standards that were enacted during these two decades may have played a role in these reductions.

Figure 10. **Natural Gas Use in San Francisco, 1990-2010**



Major renovations and retrofits are a key opportunity for improving the performance efficiency of existing buildings. For instance, new boilers are at least 80% efficient compared to the 60% efficiency of systems they typically replace. Additionally, residents rarely add new equipment or appliances that use natural gas in their homes in contrast with electrical equipment and appliances, which have increased in use.

Energy in Buildings Trend Summary

GHG emissions from buildings in San Francisco—electricity and natural gas combined—declined by 20.3% from 1990 to 2010. These environmental gains occurred primarily because of the closure of the local fossil fuel power plants and a simultaneous systemwide decrease in the carbon intensity of electricity produced by PG&E and produced and procured by SFPUC. Over the 20-year period, the utilities' emission factors went down by 19.6% and 77.7%, respectively.[1]

Table 6. **Emissions from Building Trends, 1990–2010**

Metric	2010 Trend
GHG Emissions in Buildings (mT CO_2e)	-20.3%
Electricity Use (MWh)	11.2%
PG&E Emissions Factor (lbs CO_2/MWh)	-19.6%
SFPUC Emissions Factor (lbs CO_2/MWh)	-77.7%
Electricity GHG Emissions (mT CO_2e)	-34.2%
Natural Gas Use	-2.7%
Natural Gas GHG Emissions (mT CO_2e)	-2.9%

Strategies to Reduce Emissions from Buildings

Energy Efficiency in Buildings

With San Francisco's strong green building codes, achieving LEED Gold certification is required for all new commercial construction, and local energy efficiency standards are roughly 20% above the California Title 24 Building Standards Code. The city is home to some of the most energy efficient new buildings in the nation. However, the vast majority of energy in San Francisco is used by older buildings, many built prior to the introduction of building energy codes, and significant opportunities still exist to reduce this usage. In addition to working to make all new buildings green and highly efficient, the City is seeking to reduce energy use in existing buildings through two primary approaches: improving building performance through retrofits and recommissioning; and encouraging conservation and energy-efficient practices by building occupants.

Success Stories

SF Energy Watch

Launched: 2006

Goals: reduce GHG emissions and support historically underserved energy efficiency markets

Metrics: number of energy efficiency projects installed in commercial and multifamily properties, dollar savings to customers, and energy use and GHG reductions

Background: In partnership with PG&E, the SF Energy Watch program serves hard-to-reach small businesses, medium-sized commercial buildings, and multifamily buildings. Small businesses—truly the lifeblood of San Francisco's diverse, multicultural neighborhoods—qualify for high incentives and turnkey services through the program, starting from an energy assessment at no cost, followed by full project management through the completion of the installation by the program's participating contractor. These turnkey services are beneficial to small business owners who have limited time to examine the latest technology on the market. SF Energy Watch's team of multilingual energy experts can reach businesses in every neighborhood in the city.

In San Francisco, use of natural gas—for heating, cooking, and hot water—represents a substantial use of energy and accounts for 28% of the city's GHG emissions. SF Energy Watch has been able to reduce this usage by helping multifamily building owners upgrade to energy efficient equipment without compromising the comfort of their properties.

SF Energy Watch is funded by the California Public Utilities Commission through ratepayer funds and implemented in partnership with PG&E. About 3% of income collected by local utilities from gas and electric bills is used specifically for energy efficiency projects. In addition to reducing utility costs, the program creates and sustains local green-collar jobs. This replicable model—one of the largest and most comprehensive of its type in the nation—has made a significant contribution to GHG reductions and cost savings.

Results

From 2006 to August 2013, SF Energy Watch helped over 4,300 businesses and commercial buildings, and nearly 1,400 multifamily building owners complete energy efficiency projects. During this time, the program has

- saved a total of $25.8 million in utility savings,
- reduced energy demand by over 25,300 kilowatts, and
- reduced energy use by 152,930,953 kilowatt hours and therms by 1,449,175.

Overall, SF Energy Watch has reduced GHG emissions by 53,367mT, the equivalent of taking over 8,500 cars off the road or powering 25,379 San Francisco homes for a year.

Website: **sfenergywatch.org**

Building Performance

San Francisco leads the state in many of its energy efficiency programs, including Energy Watch, GreenFinanceSF, the stimulus-funded SF Home Improvement Program, and the Commercial Boiler Retrofit program. These programs cover both residential and commercial sectors, and they target single and multifamily homes along with large and small businesses. Utility bill savings are created through efficiencies in lighting, refrigeration, and heating and cooling. In addition, San Francisco aims to increase transparency in building performance and incentivize the private market to increase energy efficiency through policies focused on market transformation. To help achieve this aim, the City's building performance law adopted in 2011 requires commercial property owners to measure and disclose their buildings' energy use and conduct energy audits. The data and increased awareness is expected to drive future investments in energy efficiency.

User Behavior

Through education and outreach, San Francisco aims to increase awareness about the economic and environmental benefits of energy conservation. Simple measures such as turning off computers and equipment at the end of the business day can reduce energy use in commercial buildings by up to 15%.[2] At home, being aware of the energy draw of appliances, choosing energy efficient options such as Energy Star products and low flow shower heads, remembering to turn off lights, and plugging major appliances into power strips are all strategies that the City promotes through its residential energy efficiency programs. In addition, participation in initiatives such as the Earth Hour City Challenge—in which residents join with people around the world to turn off all non-essential lighting at the same time—help increase energy conservation.

Partnerships with SF Public Libraries to distribute energy meter to residents.

Success Stories

Green Building

(San Francisco Green Building Requirements)

Launched: 2004 for city facilities, expanded to apply to private sector buildings in 2008

Goals: ensure that all buildings—municipal, residential, and commercial—are designed and constructed to use energy, water, and material resources intelligently, provide safe and healthy indoor environments, support sustainable transportation, and minimize negative impacts on Bay Area ecosystems.

Metrics: number of buildings achieving Leadership in Energy and Environmental Design (LEED) Gold certification or GreenPoint Rating certification, and energy use reductions

Background: San Francisco's trailblazing Green Building Ordinance applies to all newly constructed residential and commercial buildings as well as major renovations to existing buildings. Every new construction project in the city must meet all applicable California regulations, beat California's Energy Code by at least 15%, and provide on-site facilities for recycling and composting, among numerous other requirements.

In addition, new commercial construction and alterations greater than 25,000 square feet must meet a LEED Gold certification. New residential buildings must meet either LEED Silver or California-based GreenPoint Rated standards. Municipally owned or leased projects that are 5,000 square feet or larger also must comply with Chapter 7 of the San Francisco Environment Code, which sets stricter criteria for city projects and requires LEED Gold certification.

Living Roof, 1 Van Ness

Results

As of the summer of 2013, San Francisco's Green Building Ordinance has

- achieved the highest per capita density of LEED-certified square footage among U.S. cities;
- resulted in 26 LEED-certified municipal projects totaling 3.7 million square feet, with 41 additional projects totaling 5.1 million square feet in the pipeline, leveraging $4.4 billion in capital budgets;
- resulted in 302 LEED-certified buildings and well over 3,000 housing units certified under LEED or GreenPoint Rated, totaling more than 65 million square feet certified to date (although predominantly office and housing, these projects include diverse retail, libraries, airport terminals and museum buildings, as well as the first LEED-certified stadium to host the World Series—for scale, San Francisco has a total rentable office square footage of 75 million square feet);
- influenced San Francisco's hosting the Green Build 2012 conference, with more than 35,000 attendees (the City's Green Building accomplishments were highlighted in keynotes, breakout sessions, and field trips); and
- led to the World Green Building Council honoring San Francisco with its 2011 Worldwide Leadership Award for Excellence in Green Building Policy.

Website: **sfenvironment.org/greenbuilding**

Zero Net Energy Buildings

Through direct rebate programs, contractor training, and support of industry-wide adoption of green building labels, San Francisco has worked closely with the emerging home performance community, PG&E, and city residents to develop the practical steps for moving single family and small multifamily buildings toward zero net energy (ZNE).[3] The City is also supporting the work of the California Public Utilities Commission in achieving the statewide goals for ZNE building—specifically, that all new residential building starting in 2020 will be ZNE, all new commercial buildings starting in 2030 will be ZNE, and 50% of existing buildings will be ZNE by 2030.[4] Achieving ZNE in a building means reducing energy use to the lowest level possible and then using renewable energy to supply the remaining energy needs on an annual basis.

Most San Francisco commercial buildings and multiunit residential buildings have insufficient solar and wind energy access to meet their annual electric and heating needs on-site. Furthermore, the density they represent provides valuable emissions reduction to the city by supporting transit oriented development, community services, and district energy opportunities. For these buildings, the city is planning to support green power solutions to meet the ZNE goals. This approach is consistent with the ZNE definition classifications authored by the National Renewable Energy Laboratory report on ZNE buildings and provides market flexibility and support for infill priority development.[5]

More ZNE strategies include

- conducting education and training to support occupants and owners;
- providing guidance and charting a path to ZNE for all building types;
- reformatting incentive programs away from single-measure, short-term savings and towards whole building multimeasure programs that are phased over multiple years to achieve deep efficiency improvements;
- providing practical, accessible financing for energy efficiency and renewable installations for every building type; and
- improving code compliance and upgrading energy codes for existing buildings to encourage and incentivize ZNE.

Photo: ©Grid Alternatives

Photo: ©AECOM

Increase Use of Renewable Energy

San Francisco intends to continue the trend of a cleaner, greener electricity supply by expanding the options for purchasing 100% carbon-free power and increasing the installation of in-city renewables on municipal properties, businesses, and homes.

100% Renewable Energy

As new options to purchase 100% renewable energy become available for residents and businesses the opportunity for significant GHG reductions arises. Moving beyond the state's RPS levels of 33% renewable electricity by 2020 to 100% renewable electricity is the largest single action that San Francisco can take to reduce GHG emissions. The actual GHG reductions will depend on what percentage of residential and commercial customers choose 100% renewable. The tables below show the GHG reduction potential under various scenarios.

Table 7. **CAS Goals for Residential Participation in 100% Renewable Energy and Associated GHG Reductions**

Year	Participation Rate	Anticipated GHG reductions/mTs
2012	0%	0
2017	5%	96,994
2020	10%	134,256
2025	45%	328,094
2030	80%	521,485

**Commercial* includes industrial and other usage.

Table 8. **CAS Goals for Commercial Participation in 100% Renewable Energy and Associated GHG Reductions**

Year	Participation Rate	Anticipated GHG reductions/mTs
2012	0%	0
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2025	45%	328,094
2030	80%	521,485

**Commercial* includes industrial and other usage.

Photo: ©SFPUC

In-City Renewable Generation

Even though most electricity comes to San Francisco from sources outside the city, increasing in-city renewable energy sources is an important strategy to reduce GHG emissions from buildings as well as to promote local economic development. The City has supported photovoltaic system installations by offering incentives, financing opportunities (such as commercial Property Assessed Clean Energy, or PACE, financing), technical assistance, and streamlining the solar permitting process. Photovoltaics eventually could provide up to 7% of San Francisco's current electricity needs.[6] Solar hot water projects, which are also supported by a range of rebates and financing opportunities, offer another opportunity for residents to save money and reduce emissions from their home energy use.

In addition, San Francisco plans to support options for those who cannot install renewable energy projects in their homes, including the city's many renters by expanding virtual net metering for multifamily properties, and by supporting state legislation to enable "community solar gardens," or "community wind" projects that will allow Californians to invest in and receive power from local, off-site renewable energy sources.

Off-shore renewable energy generation is a long-term prospect for San Francisco, as deep-water floating wind turbines and wave energy technologies move closer to commercialization. Coastal wave energy off Ocean Beach and floating wind turbines further afield eventually could generate substantial amounts of electricity for the city.[7]

photo: ©Laura Sasso

Emission Reduction Opportunities to 2030

Energy Efficiency

Scaling up energy efficiency programs and policies in San Francisco is estimated to reduce GHG emissions by 301,979 metric tons (mT) of carbon dioxide equivalent (CO_2e) per year by 2030. This will include the following components:

- compliance with the existing Commercial Building Ordinance, which experts believe will lead to an annual 2.5% efficiency improvement in the commercial building sector[8]; projected GHG reductions: 176,638 mT/year
- ratepayer-funded Energy Watch programs for energy efficiency in commercial and multifamily buildings; projected GHG reductions: 64,012 mT/year
- enforcement of green building codes, which are estimated to produce 35% higher energy efficiency than California's Title 24 for new developments (residential and commercial); projected GHG reductions: 49,620 mT/year
- an updated Residential Energy Conservation Ordinance (RECO) leading to a 2.5% improvement in energy efficiency in the residential sector (projections assume that 53,000 homes will turn over through sales over the next 10 years); projected GHG reductions: 7,508 mT/year
- a Residential Home Energy Improvement Program providing residential rebates for energy efficiency improvements; projected GHG reductions: 4,201 mT/year

Success Stories

Existing Commercial Building Energy Performance Ordinance

Launched: 2011

Goals: reduce energy use in commercial buildings, reduce GHG emissions, and help property owners save money by improving energy efficiency

Metrics: percentage of buildings that publicly report total annual energy use, percentage of buildings that complete an energy audit, and total stock earning an ENERGY STAR rating

Background: One of the first of its kind in the country, this San Francisco ordinance calls for existing nonresidential buildings of 10,000 square feet and larger to benchmark, and publicly report their energy use each year, and undergo a professional energy audit every 5 years. It ensures that property owners, managers, and tenants know how their buildings are performing and understand the most effective energy-efficiency strategies to reduce their utility costs. Although the ordinance does not force building owners to make energy improvements, the San Francisco Department of the Environment's (SF Environment) experience with voluntary energy efficiency programs has shown that understanding energy use, comparisons to performance of peers, and information about specific cost-effective opportunities each help motivate owners and managers to take action.

SF Environment's Green Building team coordinates the implementation of the ordinance. Information about compliance and energy use is accessible to the public via the City's open data website, datasf.org, and is mapped by third parties, such as the Honest Buildings website (honestbuildings.com/sanfrancisco-ecb). Training and educational support are provided for building owners, tenants, and operators so that green building and energy efficiency gains are realized and continue over time.

Photo: ©Calla Ostrander

Results

As of the spring of 2013, San Francisco's Commercial Building Ordinance has

- Affected more than 2,090 private sector buildings, totaling 152 million square feet, and 350 municipal buildings, in less than 2 years;
- Identified more than $6 million in annual energy savings opportunities and $10.7 million in energy efficiency investments from the first 195 audits submitted; and
- SFPUC documented that from 2009 to 2012, municipal buildings cut their energy use by 4.4%.

Websites:
Overall initiative: **www.sfenvironment.org/ecb**

Municipal Buildings: **sfwater.org/index.aspx?page=701**

Photo: ©Occidental Power

Success Stories

GoSolarSF

Launched: 2008

Goals: reduce fossil-fuel-based energy use, increase renewable energy generation, save residents and businesses money on utility bills, and create green jobs

Metrics: value of incentives provided, number of solar installations, total renewable energy generated, value of solar power generated, number of jobs created

Background: San Francisco's GoSolarSF is the first of its kind as a municipally operated incentive program for solar energy. Approved by the Board of Supervisors in 2007, it has helped propel San Francisco from laggard to leader in rooftop solar power, by offering financial incentives to residents, businesses, and community-based organizations to install rooftop solar systems. It offers a one-time incentive payment for local solar electric projects, to reduce the cost of installation borne by the customer. Additional incentives are provided to low-income residents, who spend a greater percentage of income on energy-related bills. GoSolarSF also helps community-based organizations increase their funds going to direct services because they have been able to reduce their energy bills and to residents in "environmental justice" neighborhoods that have historically suffered higher pollution, for example from the Hunters Point and Potrero fossil fuel-based power plants.

GoSolarSF has helped show that protecting the environment also makes economic sense. Every new megawatt (MW) of solar energy installed in San Francisco adds the equivalent of 10 full-time jobs for one year. To be eligible for a GoSolarSF rebate, participants must choose a contractor who employs graduates from one of San Francisco's workforce development programs, creating green jobs for local residents. Residents who are saving money on their utility bills each month have more to spend in the local economy. Every new MW of solar energy installed increases local spending by $1.825 million. Data from the City's Assessor-Recorder's Office indicates that once the new solar homes are sold, the City gains more than $2,000 per home in increased property taxes because homes with solar power are more valuable. GoSolarSF, and the City's broader efforts to grow a local solar market (including reducing solar permitting costs and educating residents about clean energy and providing new financing options) has helped attract nearly a dozen solar companies to San Francisco, solidifying the City's position as an emerging capital of the green economy. These companies and their employees also add to San Francisco's economic vitality.

Results

As of 2012, GoSolarSF has

- provided $15.5 million in incentives towards 2,000 solar installations, with a combined capacity of nearly 7 MW;
- reduced GHG emissions by 1,900 mT annually; and
- saved participants roughly $2 million annually on their electricity bills.

Website: **sfwater.org/gosolarsf**

Photo: ©Lumipolt

Renewable Energy Task Force

In 2011, San Francisco mayor Edwin M. Lee convened a Renewable Energy Task Force, to develop recommendations to help San Francisco achieve its goal of a 100% renewable electricity supply within 10 years. The group included 35 experts from the private sector, academia, government agencies, and advocacy organizations. After a year and a half of study, the Task Force completed its report in September 2012, presenting the mayor with 43 recommendations under three main subject areas: Energy Efficiency, Local Distributed Generation, and Utility-Scale Generation.[6] The primary strategies, a number of which are also referenced elsewhere in this chapter, are as follows:

1) **Shrink the pie:** Use energy efficiency and conservation to lower total electricity demand.
2) **Break down barriers for multitenant buildings and occupants:** Enable property owners to pass through or share the costs—and savings—of renewable energy upgrades with their tenants, and expand virtual net metering programs that allow those owners to distribute the credits from a single solar electric system to multiple tenants.
3) **Expand access to local renewable energy:** Expand customers' ability to install solar systems on-site, or invest in a community-owned solar system off-site, and receive electricity credits on their utility bills.
4) **Encourage local renewable energy:** Standardize and streamline permitting, enable stable contracts and rates that allow renewable energy projects to sell their power to the grid, and address shading of solar systems.
5) **Provide 100% renewable power purchasing options:** Develop and encourage robust green purchasing programs, and expand deliveries of 100% renewable municipal power.
6) **Encourage private-sector investment in renewable energy:** Leverage City resources (including roof space and ability to issue low-cost bonds) and consumer demand for renewable energy to promote renewable energy investment and project development by the private sector.

Photo: ©Sun, Light and Power

Success Stories

San Francisco Energy Map

Launched: 2007

Goals: increase local production of renewable energy, and increase resiliency and energy security

Metrics: number of solar and wind installations, GHG reductions, and kilowatt hours of local renewable energy produced

Background: The San Francisco Energy Map is a comprehensive map of renewable energy potential and installations around the city. It features solar photovoltaic, solar thermal, and urban wind energy sites. It is a great means for finding out where renewable projects are located in specific neighborhoods as well as obtaining information about installation costs, incentives, resources, and case studies on renewables in the city. The map has tools to evaluate the solar energy production potential of roofs on every building in the city. It allows citizens to enter a residence or business address and receive immediate data about site-specific solar energy potential and associated GHG reductions and energy savings. The map identifies solar installations by category: schools, homes, municipal buildings, and commercial buildings. It also notes those sites that are addressing the effects of environmental stressors in targeted "environmental justice" neighborhoods, many of which were provided through grants or additional incentives to low-income residents and community-based organizations.

In 2012, the Urban Wind Map was unveiled, to complement the Solar Map and create a more comprehensive view of the city's renewable energy potential. The map provides case studies of existing wind installations and wind data from weather stations around San Francisco. It specifies areas that are appropriate for small urban wind generation, to help residents decide whether installing a system is appropriate for their location.

San Francisco Energy Map
A map of clean energy activity around the city
Reset Map
Back
About | Contact Info | Got Solar? | Disclaimers | Photo Gallery | PV Solar Guide | How To Use

SF Environment's San Francisco Energy Map shows all solar and wind power installations in San Francisco. www.sfenergymap.org

Results

Each quarter, the San Francisco Energy Map calculates cumulative data on the positive effects of San Francisco's renewable energy installations, and fall 2012 calculations has

- indicated 3,489 solar energy systems installed, producing 28,605 MWh per year, and saving customers $6.32 million on electricity bills;
- determined 21 MW of total capacity; and
- shown reduced GHG emissions by 5,776 mT.

Website: **sfenergymap.org**

Endnotes

[1] An emission factor measures the average amount of a specific pollutant or material discharged into the atmosphere by a specific process, fuel, equipment, or source. In this case, it is pounds of carbon dioxide per megawatt hour released during the generation of electricity.

[2] Reference: http://newbuildings.org/sites/default/files/PlugLoadBestPracticesGuide.pdf

[3] SF Environment, The San Francisco Zero Energy Homes Program, June 2011

[4] The Technical Potential of Zero Net Energy Buildings in California, prepared by Arup for PG&E on behalf of the California Investor Owned Utilities, December 2012

[5] Shanti Pless and Paul Torcellini, Net-Zero Energy Buildings: A Classification System Based on Renewable Energy Supply Options, technical report, National Renewable Energy Laboratory, USA, 2010.

[6] Renewable Energy Task Force Recommendations Report, September 2012, p.37. The solar photovoltaic technical potential was derived from detailed rooftop and shade modeling for SF Environment's SF Solar Map, 2010. The term "technical potential" means the amount that could be produced given current technologies, not considering costs, regulatory limitations, etc. This value only looked at rooftop shading and other obstructions, there was no verification of things like structural integrity, need for roof replacement, etc.

[7] A study funded by the SFPUC estimated that as much as 10% of San Francisco's electricity needs can be met with coastal wave energy, at a cost comparable to solar photovoltaic power.

[8] Mayor's Task Force on Existing Commercial Buildings Report: Final Report and Recommendations for the City and County of San Francisco 2009.

4 Transportation

Contribution to Greenhouse Gas Emissions

The total emissions from the transportation sector in 2010 were 2,266,322 metric tons (mT), or 43% of San Francisco's total carbon footprint. Cars and trucks produce carbon dioxide equivalent (CO_2e) when they burn gasoline or other fossil fuels such as diesel. They also have significant embedded emissions in their production. These emissions from cars and trucks are quantified by determining vehicle miles traveled (VMT) by cars and trucks in San Francisco and commuters coming into the city, and the average emissions intensity of our regional passenger vehicle fleet. Driving in personal automobiles accounts for the great majority of greenhouse gas (GHG) emissions from the transportation sector.

Mass transit systems—the San Francisco Municipal Railway (Muni), Bay Area Rapid Transit (BART), Caltrain, and ferries—are responsible for under 10% of emissions generated by the transportation sector. Each of these systems uses a different fuel source, some cleaner than others. Muni buses use a combination of biodiesel and hybrid electric propulsion (representing the lowest GHG-emitting bus fleet in the nation), and Muni trolley coaches and light-rail vehicles draw on electricity from the San Francisco Public Utilities Commission's Hetch Hetchy Water and Power hydroelectric system (which has no GHG emissions). BART, as a Pacific Gas and Electric (PG&E) Direct Access customer, buys its own electricity with emissions roughly similar to PG&E's power profile. San Francisco taxis are a mix of natural gas vehicles and fuel-efficient hybrids. Caltrain uses diesel for its commuter trains. Estimates of fuel used by ferries also are included in the transportation-sector-generated GHG emissions totals. Virtually all of these transit system have plans to phase out fossil fuels in the next 10 to 15 years.

Table 9. **Trends in Transportation Sector 1990–2010**

Metric	2010 Trend
Transportation GHG Emissions	1.5% ↑
Vehicle Miles Traveled	7.2% ↑
Fuel Economy (mpg)	43.8% ↓
Bike Commuters	66% ↓

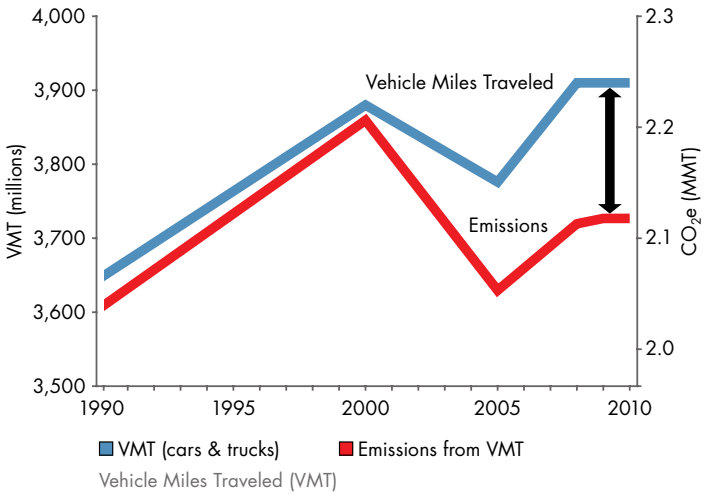
Emissions from transportation increased

2010 ↑ 34,282
1990 mT CO_2e

Trends since 1990

Between 1990 and 2010, transportation-related GHG emissions increased in San Francisco by 3.2%, rising from 2.2 million metric tons (MMT) of CO_2e to 2.27 MMT of CO_2e. Since 1990, as car ownership and commuting distances have continued to grow, the number of trips and the length of each trip being made in cars have also grown. Overall, we drive far more than we used to. In fact, the average person takes several more trips per week than was common 20 years ago. We can see this increase in driving by San Francisco residents reflected in VMT, which have increased from 3.65 billion miles in 1990 to 3.91 billion miles in 2010. However, emissions growth from transportation has slowed during the same 20-year period, as fuel economy of passenger vehicles has improved. The chart below shows an encouraging trend—VMT and emissions from those miles traveled are beginning to diverge. Fuel economy requirements and low-carbon fuel choices are enabling this trend. Nevertheless, emissions from cars and trucks in San Francisco are still rising. This pollution source remains one of the toughest challenges in developing a climate action strategy for the city.

Figure 11. **Auto Emissions Decreased per Mile Travelled as Vehicles Become More Efficient**



Strategies to Reduce Emissions from Transportation

During the past 10 years, small but perceptible shifts in San Francisco commuting patterns have helped curb the increase in VMT. Many residents are choosing to share rides and more are taking public transit, traveling by bicycle, and renting cars when they need them. In San Francisco, 30% of households do not own a car.

However, despite traffic and parking frustrations, many people still choose their cars for trips of varying distances in the city. Convenience and speed of travel are major factors. These habits persist even though 90% of San Franciscans live within two blocks of public transit service.

In order to reach our climate goals in the transportation sector we will need to make 50% of all our trips outside of the personal vehicle. As articulated in the three-tiered transportation strategy developed by the San Francisco Municipal Transportation Agency (SFMTA), the City's multifaceted program and actions will help meet the overall sustainability of the system and its support of the economy, environment, and society. This framework is centered around the principles of managing congestion, strategically growing the supply of alternatives to driving alone, and actively supporting the transition to low- and no-carbon fuels.

The ability of this strategy to reduce VMT; increase mobility through better transit, walking, bicycle, taxi, and sharing of vehicles (cars, scooters, bicycles, vans); and increase access to clean fuels is a win-win for the health, finances, and environment of the residents and businesses of the San Francisco.

The three-tiered strategy framework is as follows:

Transportation Demand Management

- Land use integration
- Congestion and parking pricing
- Travel choices and information

Strategic Infrastructure Support

- Priority transit
- Complete streets
- Vehicle and ride sharing

Efficient Vehicles, Clean Fuels

- Electrification and 100% renewable electricity
- Liquid and gaseous biofuels

Transportation Demand Management

Strategies for managing the demand for single-passenger automobiles fall into three main categories: building new housing and jobs with integrated transportation options, managing congestion and circling for parking through smart time-of-day pricing, and increasing travel choices and access to real-time transit information.

Land Use Integration

Integrating land uses is a method of leveraging development to minimize the need for driving and maximize the viability of walking, transit, bicycling, and car sharing. Several development agreements have resulted in transit passes being included in condo developments, more walking and bicycle amenities, and dedicated spots for car sharing. These approaches have shown people tend to walk, take transit more, and reduce their overall VMT when they live, work, and play closely in mixed-use neighborhoods.

Congestion and Parking Pricing

Managing congestion and parking entails working with new developments and neighborhoods to ensure that those who choose to drive get a parking space as quickly as possible. Parking circling is responsible for a significant portion of congestion, transit delay, and distracted driving, leading to pedestrian collisions. The goal of managing parking supply is to encourage alternative modes of travel. Similarly, placing a price on driving during peak traffic hours and in areas with high traffic helps to lessen congestion.

Travel Choices and Information

Access to accurate information about travel options, how to use them, and how much they cost enables people to make the best choice for their particular trip. San Franciscans are multimodal by way of life—we use many modes to reach our daily needs. Utilizing social media and direct marketing to major employers and educational, tourist, and cultural centers that generate demand for automobile trips is a key way to increase the information so that people can reach them in more sustainable ways like ride sharing, van-pooling, transit, or bicycling.

Success Stories

Land Use & Transportation Integrated Planning

Launched: 2008

Goal: reduce GHG emissions

Metrics: number of auto trips diverted

Background: Major development agreements have resulted in reduced transportation demand with increased sustainable transportation services, innovative policies to provide condo households with transit passes, increased car sharing and bicycle parking, walkable streets, parking supply and road congestion management (on Treasure Island), and better transit services.

Some 60,000 new households in the Hunters Point Shipyard, Treasure Island, Park Merced, Mission Bay, SoMa, and eastern neighborhoods will have access to these sustainable transportation options.

SFpark: Parking Demand Management

Launched: 2010

Goal: reduce growth of GHG emissions by managing parking supply and demand

Metrics: number of parking meters with SFpark program installed

Background: SFpark uses demand-responsive pricing to open up parking spaces on each block and reduce circling and double-parking. Rates may vary by block, time of day, and day of week. Rates will be adjusted by no more than 50 cents per hour down or 25 cents per hour up, and no more often than once per month. Looking for parking results in congestion, slowed-down transit, and in some cases distracted driving, leading to pedestrian and bicycle collisions. Getting drivers to their parking spot as quickly and as easily as possible in a key feature of the program.

SFpark charges the lowest possible hourly rate to achieve the right level of parking availability. In areas and at times where it is difficult to find a parking space, rates will increase incrementally until at least one space is available on each block most of the time. In areas where open parking spaces are plentiful, rates will decrease until some of the empty spaces fill. The city is expanding SFpark to meet our multiple transportation needs.

Commuter Benefits Ordinance

Launched: 2009

Goals: increase resiliency, reduce energy costs to commercial entities, create local economic activity, and reduce GHG emissions

Metrics: number of participants, reductions in GHG emissions, and reductions in VMT

Background: San Francisco was one of the first cities to take advantage of the federal government's commuter tax benefit by allowing its employees to deduct the cost of commuting through pre-tax payroll deductions.

The City marketed the program to local employers and, in 2009, took the step of adopting the Commuter Benefits Ordinance. This law, implemented by SF Environment, targets businesses, challenging them to reduce single-occupancy vehicle trips to and from San Francisco by encouraging the use of sustainable transportation modes. By 2011, nearly 40% of San Francisco employers reported offering a commuter benefits program because of ordinance requirements. In fact, one-third of these employers began offering these important benefits to their employees nationwide, which highlights the effect of the ordinance even outside San Francisco.

Commuter benefits provide much needed relief in the form of reduced commuting costs for many people who rely on public transportation to get to and from the workplace. Furthermore, such a benefits program encourages people to walk, bike, rideshare, or take public transit to their jobs, helping to relieve traffic congestion, improve air quality, and make San Francisco an even better place to live.

Results

The Commuter Benefits Ordinance has

- led 3,445 City employees to use the commuter benefits program monthly;
- reduced the taxable income of workers enrolled in a commuter benefits program and saved them up to 40% on their transit, vanpool, and parking expenses;
- saved San Francisco commuters typically between $200 and $1,000 a year;
- convinced approximately 3,000 businesses to offer a commuter benefits program to their employees, saving them an average of 9% on payroll taxes;
- resulted in over 89,000 participants in commuter benefits programs;
- meant an approximately 2.8 million miles daily reduction in VMT;
- saved 119,664 gallons of gas every day;
- reduced GHG emissions by 255,000 mT annually; and
- achieved a 12% reduction in the City's GHG emissions related to cars and trucks.

Strategic Infrastructure Support

Managing demand can shift some of those would-be automobile trips into more sustainable travel options, which means greater pressure on existing systems. Therefore a key component of this strategy is to strategically increase supply and capacity of the transit, bicycle, walking, and vehicle sharing networks.

Priority Transit

More people are choosing to take transit, and San Francisco has one of the most extensive transit systems; however, it is often very crowded and unreliable mainly due to traffic congestion. The city is creating more dedicated transit lanes to improve reliability and adding more transit vehicles so more people can switch from driving to transit. This is one of the greatest components of meeting our city's sustainability goals and reducing our carbon footprint in the city.

San Francisco's transit system faces major challenges, including inadequate funding for operations, cuts in services, lack of peak hour capacity, and the need for significant capital investments just to maintain existing infrastructure in a state of good repair (approximately $12 billion needed through 2030).

Deferring investments in transit maintenance and expansion is not an option if San Francisco is serious about reducing GHG emissions. SFMTA, BART, Caltrain, and other regional transportation partners must be prepared to generate the needed revenue to invest in key corridors, complete regional transit expansion projects, and ensure fast and reliable operations. The existing transit service must be improved and expanded by reallocating scarce funds, dedicating transit lanes to improve reliability, and securing new funding sources. San Francisco's future as a sustainable city will depend greatly on transit upgrades and expansions region-wide.

SFMTA has set a goal of lowering automobile mode-share from 60% to 50% over the next five years. The agency plans to implement several major transit improvements:

- The Central Subway will provide new rail service from the Caltrain Depot across downtown, to Chinatown.
- Van Ness Bus Rapid Transit service will be followed by a similar exclusive bus lane service on the Geary Corridor.
- Major enhancements to existing transit, bicycle, and pedestrian service will occur through the Transit Effectiveness Project and the 2013 Bicycle and Pedestrian Strategies.

Complete Streets

Designing streets that accommodate a wider range of people's needs creates a pleasant urban environment for all users: those in stores, on sidewalks, on bicycles, on public transit, and in cars. Landscaping sidewalks and medians also strengthens the urban forest, a recognized carbon sink for the city. In this regard, San Francisco is implementing Complete Streets policies through the San Francisco Department of the Environment's Better Streets Plan, the Planning Department and SFMTA's WalkFirst project, and SFMTA's Bicycle Plan and Transit Effectiveness Project. Benefits of these strategies include the following:

- improved transit reliability and operational cost savings through dedicated lanes and bus stop consolidation
- improved public health through the promotion of walking, bicycling, and comfortable streetscapes
- reduced noise, air, and groundwater pollution through permeable pavements
- reduced transportation-related costs to society (such as collisions, hospitalization, and legal costs), saving tens of millions of dollars annually
- reduced travel time for residents
- improved public safety

Moreover, by modifying the built environment and encouraging changes in travel choices, Complete Streets can lead to lasting GHG emissions reduction. In conjunction with the Departments of Public Works and Planning, SFMTA is implementing the 2013 Bike Strategy, as well as better integrating the use of bicycles with the transit system, facilitating protected bikeways, and improving bike parking.

Dedicating more street space to people rather than cars goes a long way in increasing the attractiveness of walking and bicycling. San Francisco is already one of the most walkable cities in the nation, and dedicating more space for walking benefits the environment, our public health and safety, and the economy. Similarly, bicycling has the lowest carbon footprint per passenger mile compared to other modes of transportation and San Francisco has experienced a 66% increase in bicycling with minimal investment in bicycle lanes and bicycle parking. Growing the network and launching the Bike Share program in 2013 will see this number grow even higher. In addition, bicycling helps transit capacity as short peak-period transit trips are better reached by bicycling, is great at meeting our public health and local economy goals, and most of all, is a fun way to get around the city.

Vehicle and Ride Sharing

While the city strives to make it attractive for people to walk, bicycle, and take transit, there will continue to be a need for trips made by vehicles. Vehicle and ride sharing harnesses the changing preferences of car ownership and the collaborative economy that is expanding the value of sharing services in the city. Sharing allows people to have on-demand mobility without the hassle of owning, operating, or parking a car (or bicycle or scooter). Many organizations (car share, scooter, bicycle rentals) have been providing these services, and they are growing throughout the city. The launch of Bike Share is the capstone in the city's "mobility menu" of service being offered to create a diverse set of transportation options to meet our growing needs. Finally, taxis, and shared taxis provide complementary service for those times when transit, walking or biking are not sufficiently convenient.

Success Stories

San Francisco Bicycle Plan

Launched: 2009

Goals: reduce GHG emissions, reduce congestion, make bicycling an integral part of daily life in San Francisco, increase safe bicycle use, and refine and expand the existing bicycle route network

Metrics: number of new bike riders and amount of VMT reduced

Background: The San Francisco Bicycle Plan makes bicycling a safer and more attractive way to travel locally and puts San Francisco in the forefront of bicycle-friendly cities in North America. It calls for 60 new projects, representing a total of 34 additional miles of bicycle lanes, a 76% increase over existing facilities. Set to be adopted in 2006, the plan was challenged on the adequacy of the its review under the California Environmental Quality Act, which led to the preparation of an Environmental Impact Report. In 2009, SFMTA approved the plan as a whole, and the Superior Court partially lifted the injunction that prevented almost all physical improvements to San Francisco's bicycle network.

Even while the plan was being challenged, bicycling increased dramatically in San Francisco, rising 53% between 2006 and 2009. Bicycling along the Wiggle, the route that guides bicyclists along the flattest streets from mid-Market to the Panhandle, increased by 85% in that same period. One of the first projects completed when the injunction was lifted was improving the Wiggle, celebrated by a group of Wiggle enthusiasts with original music and enshrined in a YouTube video.

Photo: ©Tim Pargardreou

Photo: ©Kate McCarthy, Flickr

In addition to bicycle lanes, the City is implementing other creative measures to ensure bicyclist safety. Sharrows—shared-lane street markings that indicate bikers can use the full lane—were pioneered in San Francisco and remind motorists to share the lane and help keep bicyclists away from open doors of parked cars. Green bike boxes—painted green spaces on the road with white bicycle symbols inside—provide a separate, protected place for bicyclists to stop in advance of intersections.

The City is pursuing innovative approaches to better bicycling, including buffered bike lanes, colored bike lanes, bicycle-friendly traffic signal timing, separating bikeways, bicycle sharing, helping owners of existing commercial buildings to either provide secure bicycle parking in their buildings or allow their tenants to bring their bicycles into the building. To the greatest extent possible, projects are coordinated with repaving or construction projects to maximize efficiency and minimize disruption.

Results

The San Francisco Bicycle Plan has

- successfully guided 50 projects, including striping almost 25 miles of bicycle lanes and painting 2,500 shared-lane markings, or sharrows, since its official approval in 2009;
- assured that approximately 4.5 more miles of bicycle lanes will be added in 2013, along with an estimated 500 bike racks, and that an estimated 3,000 sharrows will be added through 2014; and
- foreseen the Bike Share program.

Website: **sfmta.com/cms/bhome/homebikes.htm**

Photo: ©Tim Pandreou

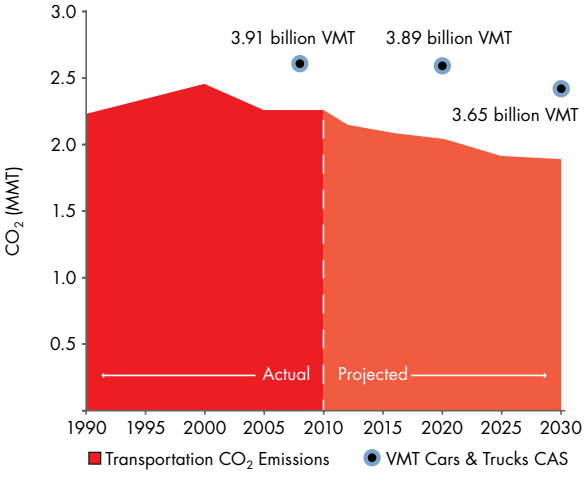
Efficient Vehicles, Clean Fuels

San Francisco is expanding access to clean vehicles and clean fuels. With the increase in biofuels and the transition to hybrids, Muni's GHG emissions have decreased. The City & County's top municipal GHG emissions reduction strategy is to increase this blend to 50%, and then to 99%. The City also is seeking to identify the most sustainable low-carbon fueling options for vehicles operating in San Francisco, including biofuels, compressed natural gas from biodigesters, and electricity. The initial efforts are focusing on municipal and private fleets, delivery vehicles, and transit districts serving the city. In evaluating specific types of biofuels for use in San Francisco, the following criteria are being considered:

- maximizing GHG emissions reduction and sustainability
- minimizing total fuels costs and the adverse effects of criteria pollutants
- ensuring the availability of fuel

Electric vehicles (EVs) and the electrification of Caltrain remain an important piece of the climate action strategy. The City is working to ensure that existing and potential EV owners can find adequate charging infrastructure at public and workplace locations, and that overnight, off-peak charging is available at residences, including multifamily buildings. The City also is adding plug-in vehicles to its municipal fleet and is encouraging plug-in adoption for taxis and car share organizations. In addition, the City is supporting public outreach to educate and motivate San Franciscans to drive EVs and property owners to become EV-ready. The City is also working to support Caltrain's electrification and is supportive of BART's goals to increase the carbon-free content of its electricity supply.

Figure 12. **Transportation CO_2e Emissions Decrease as Vehicle Fuel Economy Improves**



Success Stories

Green Taxi Program

Launched: 2008

Goal: reduce GHG emissions

Metrics: number of taxis complying and GHG reductions

Background: As a thriving urban metropolis, San Francisco has a robust taxi industry with approximately 2,000 vehicles. Each one covers approximately 90,000 miles annually, delivering passengers to citywide destinations.

The City's Green Taxi Program was spearheaded by a taxi driver, not by a politician. The first cabbie to occupy a seat on the San Francisco Taxi Commission recommended that clean taxis be placed on the agenda at the first commission meeting, in 1997. Commission members considered whether an alternative to high-emission vehicles existed and discovered only one—a compressed natural gas taxi. Fortunately, hybrid automobiles entered the marketplace in the early 2000s, and in 2004, San Francisco became the first US city with a fleet of hybrid taxis on its streets.

Based on the success of that first fleet of hybrid taxis, the City saw the potential for substantial reductions in GHG emissions by promoting an even greener taxi fleet. The City worked with its Taxi Commission to have a policy of having as little negative financial impact as possible. In 2008, the City passed the Green Taxi Ordinance, specifying a reduction of average fleet GHG emissions by 20% below 1990 levels within four years (the standard amount of time it takes taxi companies to turn over fleet inventory). The City also produced a Green Taxi Guide, to help the companies select appropriate vehicles. Although the number of taxis has almost doubled, San Francisco realized a 10% reduction in emissions by 2011.

Hybrids continue to be strongly favored by taxi drivers because of their tremendous savings in fuel costs. Furthermore, they appeal to taxi owners because their brakes last longer than those on gas-powered cabs, which is a strong selling point in hilly San Francisco. On average, brakes in a gas-powered vehicle driven 135 miles a day up and down San Francisco's hills last 30 days, while alternative fuel vehicle brakes driven the same distance over the same terrain last six to eight months.

San Francisco's green taxi fleet showcases the City's commitment to mitigating climate change in a very public way to residents and its 15 million annual visitors.

Results

The Green Taxi Program has

- influenced 98% of San Francisco's eligible taxis to be hybrid or compressed natural gas;
- reduced GHG emissions by 35,159 mT annually, which is the equivalent of taking 6,890 passenger vehicles off roadways;
- saved taxi drivers $11 million in fuel costs annually;
- led to an average 49% reduction in GHG emissions annually for a San Francisco taxi, from 59 tons in 1990 to 30 tons in 2011; and
- not affected the approximately 90 service vehicles transporting disabled passengers, which are not subject to clean air vehicle requirements because of the lack of acceptable alternative fuel, wheelchair-accessible vans available on the market.

San Francisco's landmark Green Taxi Policy has reduced emissions and saved drivers money.

Success Stories

Muni Biodiesel Use

Launched: 2006

Goal: reduce GHG emissions and toxic air contaminants from diesel

Metrics: reductions in GHG emissions

Background: When it comes to the use of alternative fuels and greening San Francisco's fleet of municipal vehicles, the City continues to demonstrate leadership and commitment on every front. By 2007, all of the City's 1,500 diesel vehicles—buses, several fire engines, ambulances and street sweepers, among others—were converted to run on biodiesel, displacing roughly 1.2 million gallons of diesel fuel annually. Most of the biodiesel used is B20, a mix of 20% biofuel and 80% petroleum diesel fuel.

San Francisco is the proving ground for programs that have positive results for the environment, the economy, and public health. In 2007, San Francisco launched SF Greasecycle, a citywide program to collect waste oil from the thriving restaurant industry. The waste oil is converted to biodiesel to fuel City's vehicles, the first program of its kind in the country. Previously, waste fats, oils, and grease contributed to blockages and backups in the city's sewer system, costing $3.5 million in annual cleanup. Restaurants now pay contractors to collect the waste. The grease collection program results in an estimated 1.5 million gallons of biodiesel each year, saving money for the City and its taxpayers. In addition to greening its own fleet, in 2009, the City started requiring contractors who work on municipal construction projects to use biodiesel in off-road vehicles and on-the-job equipment.

The Bay Area is second only to Los Angeles in health impacts from diesel pollutants. Use of biodiesel by the municipal fleet has substantially reduced diesel exhaust, a toxic air contaminant linked to an array of serious health problems. Biodiesel usage also reduces CO_2e, hydrocarbons, toxic air pollutants, and GHG emissions.

Results

The City's strategy has

- led to the conversion of 100% of the City's 1,500 diesel vehicles to run on biodiesel, which is sourced from San Francisco waste cooking oil;
- achieved more than 10,000 mT in GHG emission reductions annually;
- reduced particulate matter by 50%, asthma precursors in 50 sulphur compounds by 90%, polycyclic aromatic hydrocarbons by 90%, mutagens by 90%, and carcinogens by 90%, making them less toxic than table salt; and
- saved local businesses $1 million annually by avoiding grease collection charges.

Website: **sfmta.com/cms/bhome/homebikes.htm**

Photo: ©AECOM

Dog Patch Biofuel is the first and only public biodiesel station in San Francisco, it was launched with the help from the SF Carbon Fund in 2009.

Emission Reduction Opportunities to 2030

Substantial shifts in personal travel choices away from the personal automobile with the simultaneous replacement of petroleum-based fuels with low-carbon fuels and vehicles will be essential if San Francisco is to meet its GHG emissions reduction goals over the next 20 years. Investment in public transit, bicycling, and walking infrastructure as well as continued exploration and use of non fossil fuels will be required to achieve this shift. If all local policies listed in this strategy are fully implemented, 2030 emissions from the transportation sector are expected to be 508,000 mT lower than 2010 levels. Several state policies are also projected to have a significant impact in reducing the emissions from transportation in San Francisco, resulting in a reduction of 806,959 mT in 2030.

Local Policies

Investing in new transportation infrastructure in order to expand our transit, bicycle, walking, and vehicle sharing networks is expected to result in a reduction of 72,000 mT.

The expansion of clean vehicles and utilization of clean fuels is expected to yield another 217,000 mT. Specifically, a switch to 100% renewable electricity by Caltrain and BART and the increased presence of EVs in the automobile fleet is expected to result in a decrease of 148,000 mT, 59,000 coming from personal EVs and electric taxis and 89,000 mT coming from the transit systems. Switching Muni to 100% carbon-free fuels would result in a difference of 69,000 mT in 2030 compared with 2010.

Table 10. **Transportation Choice by Mode Used by San Franciscans under the CAS**

	2010	2050
Automobile	62%	20%
Public Transit	17%	40%
Bicycle	3.5%	40%
Walking	17.5%	
TOTAL	100%	100%

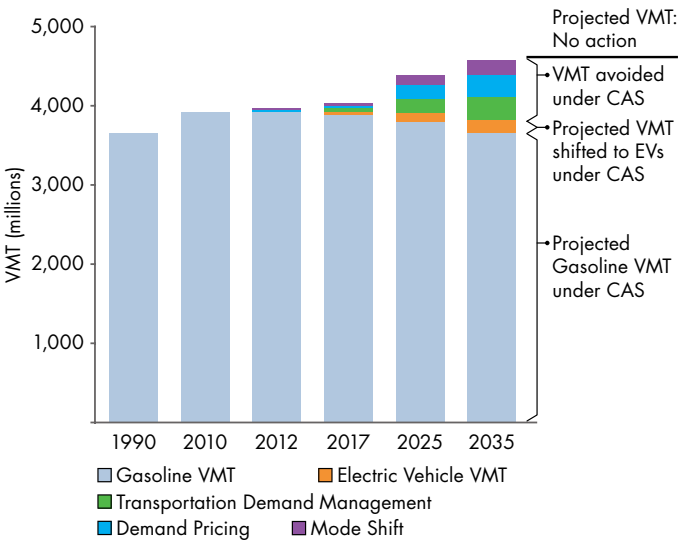
State and Federal Policies

San Francisco is benefiting from state and federal regulatory policies that support more efficient vehicles, low-carbon fuels, and sustainable infrastructure improvements.

California's Clean Car Standards law (Assembly Bill 1493, Pavley) passed in 2002 and was the first effort in the United States to regulate GHG emissions from automobiles. The law is intended to cut emissions from new passenger vehicles for model years through 2016. This state standard, which now has been adopted by the U.S. Environmental Protection Agency, will get increasingly tougher over the next 15 years and ultimately will lead to car fleets delivering an average of 54.5 miles per gallon by 2025. These planned improvements in fuel economy offer one of the most promising opportunities to reduce emissions from cars and trucks, and will lead to direct benefits for San Francisco.

The Low-Carbon Fuel Standard and The Sustainable Communities and Climate Protection Act of 2008 (Senate Bill 375, Steinberg) are two other important state policies that will also reduce emissions from transportation in San Francisco by phasing in cleaner fuels and encouraging integrated transportation options with new developments. These emissions reductions are included in the projected emissions factor for cars and trucks and in VMT associated with new developments.

Figure 13. **Projected VMT Reductions from CAS Transportation Policies**



Endnotes

[1] 100% of trips within San Francisco, one-way commuter trips, and no pass through trips are counted. VMT Source SFCHAMP.

[2] SFMTA, 20 Year Capital Plan, 2011.

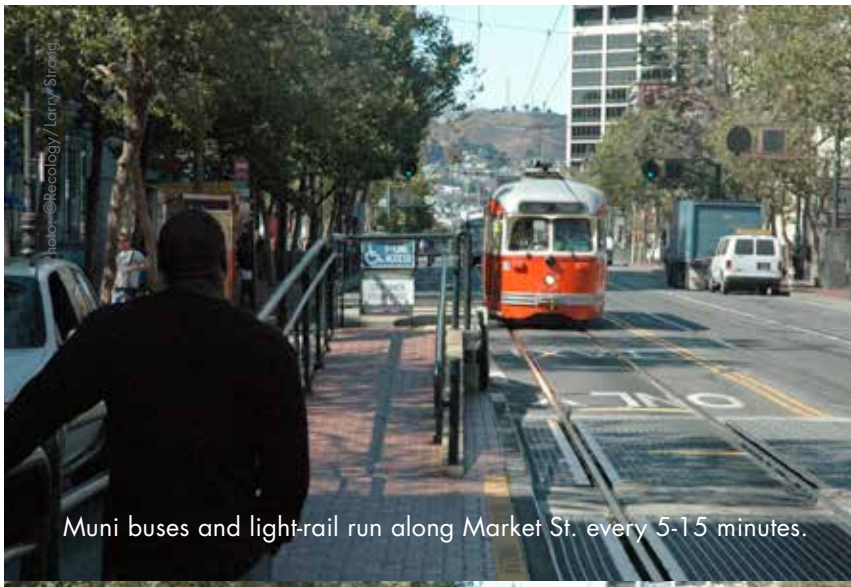
[3] San Francisco Planning Department, San Francisco Better Streets Plan, December 2010.

[4] San Francisco Planning Department, SFMTA, et al., WalkFirst: Improving Safety and Walking Conditions in San Francisco, October 2011.

[5] SFMTA, San Francisco Bicycle Plan, June 2009.

[6] SFMTA, Transit Effectiveness Project, available: http://www.sfmta.com/cms/mtep/tepabout.htm, 2013.

[7] Jason Barbose, University of California, Berkeley Goldman School of Public Policy; Yuri Yakubov, University of California, Berkeley Haas School of Business; Bill Zeller, San Francisco Department of the Environment, City and County of San Francisco Transportation Biofuels Planning Study, May 2012.



Muni buses and light-rail run along Market St. every 5-15 minutes.

Electric vehicle charging stations are now located in 20 public locations across the city.

5 Zero Waste

Photo: ©Recology/Larry Strong

Contribution to Greenhouse Gas Emissions

Reducing the amount of stuff we buy and recycling and composting our waste has substantial climate effects. As waste decomposes in the landfill, it produces methane, which is a particularly strong greenhouse gas (GHG).[1] In addition, when discarded materials are sent to a landfill, we are wasting valuable resources and energy. In 2010, the GHG emissions generated by waste sent to landfill made up approximately 5%, or 245,000 metric tons (mT) of the City's total GHG inventory.

Although smaller than other sector emissions, the diversion of waste from landfill is more important than the 5% of emissions would suggest and is an integral part of San Francisco's long-term energy and climate strategy. Materials from the waste stream that are captured for reuse, recycling, and composting close an important energy loop and keep carbon in industrial and soil nutrient cycles. By putting as much material and resources back into manufacturing systems as possible, we minimize the need to generate and harvest virgin materials. The recycling of paper has an additional carbon sequestration effect through forest conservation. Applying compost made from food scraps on farm lands reduces the use of petroleum-based fertilizers and need for irrigation as well as sequesters higher amounts of carbon in the soil. Recovered energy can also be re-used as a domestic energy source. Anaerobic digestion of food scraps and other organic materials produces biogas that can be used to offset fossil fuel use in vehicle fleets and buildings, closing another important energy loop and further reducing emissions.

Photo: ©Recology/Larry Strong

Emissions from waste sent to landfills decreased

1990 ⋮ 228,021
2010 ↓ mT CO_2e

Trends since 1990

The City has created and implemented a mix of policy initiatives, ordinances, and resolutions to capture its solid waste opportunities. It has set an ambitious goal of zero waste by 2020 and has lead by example while encouraging businesses, visitors, and residents to follow suit. The following actions have set the stage for dramatic results:

May 2004: Green Building Ordinance, requires contractors and developers to manage debris and provide adequate recycling storage space in buildings

July 2005: Precautionary Purchasing Regulation, sets recycled content and other guidelines for commodities regularly purchased by City departments

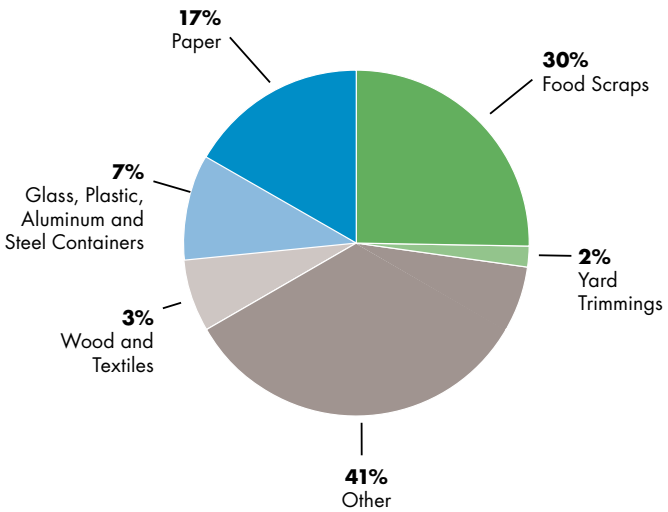
July 2006: Construction and Demolition Debris Recovery Ordinance, creates a mandatory program to maximize the recycling of construction and demolition (C&D) debris

November 2006: Food Service Waste Reduction Ordinance, requires restaurants and food vendors to not use Styrofoam food service ware and instead use food ware that is recyclable or compostable

March 2007, Expanded 2011 Plastic Bag Reduction Ordinance, requires the use of compostable plastic, recyclable paper and/or reusable checkout bags by stores

June 2009: Mandatory Recycling & Composting Ordinance, requires all San Franciscans to separate recyclables, compostables and landfilled trash

Figure 14. **Composition of Waste Sent to the landfill from San Francisco**



Waste characterization by San Francisco Department of the Environment (SF Environment) Zero Waste Team.

In 1990, the City diverted only 35% of waste from landfill. Consumption of goods and waste generated has increased substantially since 1990, but by 2010, San Francisco was recycling or composting 80% of all materials discarded in the city. A high diversion rate has outpaced an overall increase in the production of waste, thereby reducing waste-related GHG emission from 473,000 mT in 1990 (7.7%), to 245,000 mT in 2010 (4.7%).

San Francisco has had a pay-as-you-throw system since 1932, requiring residential and commercial customers to pay collection fees based on the volume of trash produced. The same principle has been maintained to encourage diversion. Residents pay less as they increase the amount of material they recycle and compost. If they manage to divert enough waste to recycling and composting, they can opt to use a smaller (and less expensive) trash bin. Businesses that participate in the City's Diversion Incentive Program can save up to 75% off their refuse bill.

The City works with a collection and processing service provider, Recology, on programs and facilities needed to achieve its zero waste goals. Recology operates similar to a regulated utility, with the City approving the programs and service rates. To complement the financial incentives that both residents and businesses receive to reduce waste, the City helps set annual diversion and disposal goals.

Crops grown with San Francisco compost

Success Stories

Mandatory Recycling and Composting Ordinance

Launch: 2009

Goal: achieve zero waste to landfills by 2020

Metrics: tons of waste diverted from landfills, percentage of compliance with the Mandatory Recycling and Composting Ordinance

Background: In 2009, the San Francisco Board of Supervisors passed the Mandatory Recycling and Composting Ordinance, to support the City's goal of zero waste to landfills by 2020. The ordinance requires everyone in San Francisco—whether in restaurants, hotels or apartment buildings—to separate their refuse into recyclables, compostables, and landfill trash.

The City's representatives go door-to-door, visit apartment buildings, and traverse commercial corridors to see that everyone has the information and resources they need to be successful. The City offers free assistance, as well as multilingual training and materials, to help property managers and business owners implement composting and recycling, and save money. Once they are active participants, the owners and managers of commercial properties provide information and annual training to tenants, employees, and contractors, including janitors, on how to comply with the ordinance.

Results

The City's Mandatory Recycling and Composting Ordinance has

- saved businesses participating in the City's Diversion Incentive Program (implemented in July 2006) up to 75% off their refuse bill; and
- supplied 98% of San Francisco's 8,600 apartment buildings with a green bin composting service.

Website:
sfenvironment.org/zero-waste/recycling-and-composting

Figure 15. **2008 GHG inventories**

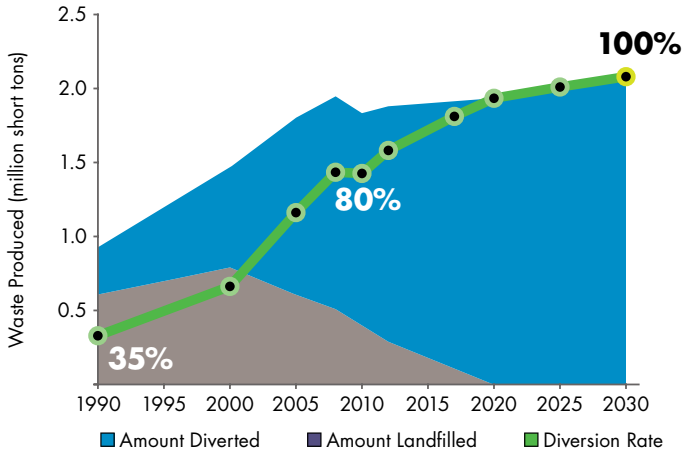


Table 11. **Trends in the waste sector 1990-2010**

Metric	2010 Trend	Baseline
Waste GHG Emissions (mT CO_2e)	-48.2%	1990
Generated (short tons)	96.7%	1990
Landfilled (short tons)	-33.4%	1990
Diverted (short tons)	337.5%	1990

Strategies to Reduce Emissions

Of the 20% of San Francisco's waste that ended up in landfill in 2010, about half was recyclable (mostly construction debris and paper) or compostable (primarily food scraps). Ongoing strategies to reduce GHG emissions include the following:

- banning the use of Styrofoam and other brands of polystyrene foam (a very common polymer, making up such everyday items as cups, plastic cutlery, packing "peanuts," CD jewel cases, and insulation) in City departments and by food service operators
- banning the use of non-compostable plastic bags, a court-upheld action, supported by the Clean Seas Coalition, and a ground-breaking step that has been followed by over 40 municipalities in California and others around the world
- requiring every event held in San Francisco to offer recycling and composting by providing specifically marked bins and arranging for collection of recyclables, compostables, and landfill trash

- reducing packaging in collaboration with legislators, producers, wholesalers, retailers, and consumers
- reducing GHG emissions from food through campaigns, legislation, and education that emphasizes switching to less carbon-intensive foods and reducing food waste
- reducing consumption through campaigns, legislation, and education focused on consuming fewer products, encouraging a sharing economy, and supporting more efficient production with less carbon-intensive products
- increasing diversion of construction and demolition material through further implementation of Construction and Demolition Debris Recovery Ordinance
- supporting the expansion of producer responsibility laws, to result in more efficiently designed products that use fewer materials and can be more easily reused and recycled
- continuing outreach and assistance to residents and businesses, to strengthen compliance with mandatory source separation of recyclable and compostable materials

These efforts are helping to achieve the highest and best use of materials, as called for in San Francisco's zero waste policy. Several of the results are discussed in the zero waste success stories in this chapter.

SF Environment Now staff conduct door-to-door waste audits and outreach in San Francisco neighborhoods.

The "fantastic three": recycling, compost, and landfill

Success Stories

Food Service Waste Reduction Act

Launch: 2007

Goal: keep Styrofoam pollutants out of the bay, ocean, and landfills

Metrics: number of compliant businesses

Background: In 2007, the Food Service Waste Reduction Act was passed, requiring restaurant owners as well as City departments to stop using Styrofoam and other brands of the polystyrene foam. The manufacturing of these materials uses nonrenewable sources for production, and the final products are non-recyclable and do not break down naturally in the environment. Polystyrene food ware is one of the most common pollutants plaguing San Francisco Bay and the Pacific Ocean.

The legislation applies to San Francisco's more than 4,500 restaurants. Like so many other programs, the initial success of the ban on Styrofoam relied on door-to-door, multilingual outreach. City officials enlisted committed volunteers to join its Styro Busters, to talk to restaurant owners in neighborhoods citywide.

When the program began, it was hard to find suitable replacement products at competitive prices. The City vetted products to check that they were, in fact, compostable or recyclable, and provided this list to restaurants to help them achieve the goal of the ordinance. A large number of compliant products and vendors are now available to choose from, and the costs of these goods and services are competitive with Styrofoam.

Results

The City's Food Service Waste Reduction Act has

- achieved nearly 100% compliance citywide;
- reduced the 7 million pounds per year of polystyrene once used in San Francisco for food service purposes; and
- created a growing local market for recyclable and compostable food ware.

Website: **sfenvironment.org/policy/food-service-waste-reduction-ordinance**

Emission Reduction Opportunities to 2030

The City's near-term, specific project opportunities to progress towards zero waste include the following:

- developing a zero waste facility, to reduce operational costs, increase material processing efficiencies and recover compostables and recyclables that have not been source- separated
- utilizing anaerobic digestion of food-rich material, both source separated and recovered from mixed waste, to produce biogas for fueling collection fleets and buildings
- working with local, national, and international businesses and institutions to develop the secondary materials market for recyclables, compostables, and their post processed derivatives
- decreasing use of disposable products by conducting upstream waste prevention campaigns and material bans, similar to those already implemented for plastic bags, to-go containers, and Styrofoam)
- increasing reuse, recycling, composting, and recycled content of products through producer responsibility initiatives

Collectively, the City's efforts are moving San Francisco towards zero waste by 2020. Achieving this goal will require continued funding from refuse rates for outreach as well as enforcement of mandatory recycling and composting requirements. In addition, new funding will be needed to test technologies and develop facilities to best recover recyclables and compostables from unsorted mixed waste.

Because GHG emissions from waste start when products are made and then continue with shipping, storage, use, and end-of-life management, the biggest way to reduce these emissions is not to create waste in the first place. Following the principles of REDUCE, REUSE, RECYCLE, the City will continue to lead the way in reducing low-value consumption—by encouraging reuse, purchasing higher quality products that don't need replacement as often, and localizing the consumption economy.

Success Stories

Checkout Bag Ordinance

Launch: 2007

Goals: reduce plastic bags pollution in the city, bay, and ocean, reduce the environmental costs and emissions associated with plastic bag production

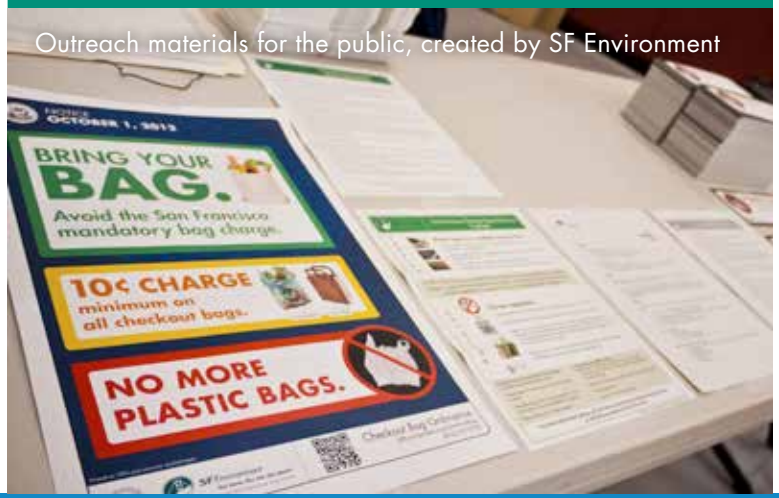
Metrics: number of compliant businesses, reduction in single-use bags

Background: In 2007, San Francisco banned single-use plastic checkout bags in certain types of retail stores. In 2012, the ban was extended to include all retail stores, and a 10-cent charge was added on allowed checkout bags—certified compostable plastic, recyclable paper with 40% post-consumer recycled content, or having a reusable design for at least 125 uses.

The purpose of the Checkout Bag Ordinance is to reduce litter and the approximately 7 million plastic bags that pollute the San Francisco Bay and Pacific Ocean each year, as well as to decrease the number of plastic bags contaminating City recycling facilities. Stores save money in checkout bag purchases. Shoppers are encouraged to bring their own checkout bags and avoid the bag fee. Those participating in food stamp programs are exempt from the charge. Other low-income residents and seniors are able to avoid bag costs by bringing their own bags to stores.

Like many of the City's ambitious efforts, extending the plastic bags ban was subject to push-back from certain groups and individuals who demanded reports on the impact of plastic bags on San Francisco Bay. Similar to other initiatives, the ban was challenged and upheld in court, allowing the City to go forward with an extensive outreach and education campaign.

The City hosted free bag vendor fairs in several major shopping neighborhoods. These offered a great opportunity for store owners to see examples of acceptable recyclable,



Outreach materials for the public, created by SF Environment

compostable, and reusable checkout bag options, and to receive free, reusable, high quality cloth bags, courtesy of SF Environment.

Results

San Francisco's Checkout Bag Ordinance has

- meant 5 million fewer plastic bags used by consumers every month;
- gained the support of environmental groups, the San Francisco Chamber of Commerce, the California Growers Association, and the San Francisco Small Business Commission;
- spared marine life, influencing a global effort in collecting millions of plastic bags from beaches around the world to prevent killing or injuring hundreds of turtles, whales, birds, and fish;
- spared landfills and the countryside from continued onslaught from plastic bags that take up to 100 years to biodegrade; and
- continued to be actively enforced by the City, whose staff distributed over 10,000 free reusable bags in September and November 2012, with plans to distribute a total of 17,500 free reusable bags.

Website: **sfenvironment.org/article/prevent-waste/checkout-bag-ordinance**

Outreach materials for the public, created by SF Environment

Photo: ©Recology/Larry Strong

SF Environment Zero Waste staff attend community events to increase awareness of San Francisco waste laws.

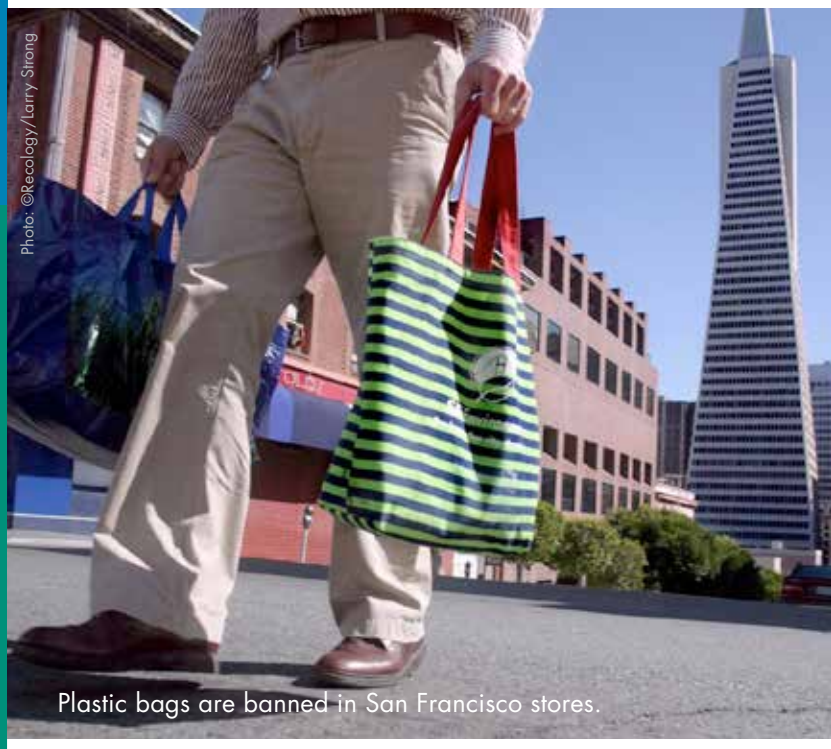


Photo: ©Recology/Larry Strong

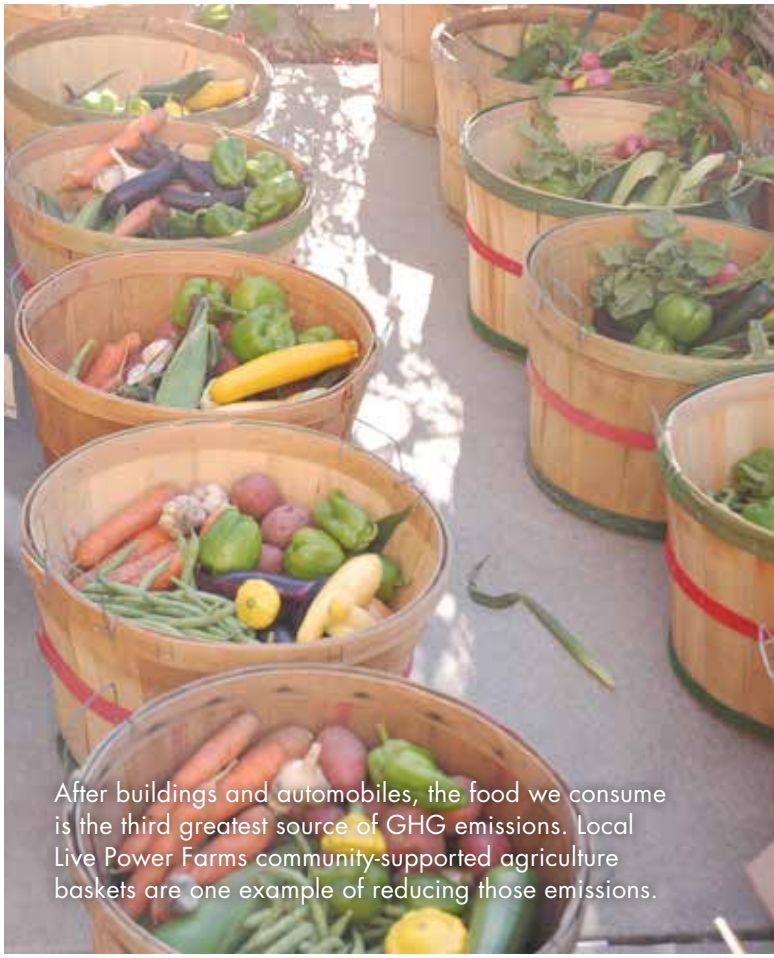
Plastic bags are banned in San Francisco stores.

Alternative GHG Inventories: Measuring San Francisco's True Climate Impact

In keeping with traditional reporting protocol, the GHG inventory calculated for San Francisco has focused on accounting for GHG emissions associated with the fossil fuel and electricity consumed citywide. This method vastly understates the actual climate impacts of San Francisco's economy. Everything imported to, manufactured in, or consumed in San Francisco has a carbon footprint.

In particular, the GHG emissions that the traditional inventory method measures from landfills represent just a fraction of the emissions associated with the production of products and the waste produced along the way. For every ton of material that goes to a landfill ("downstream" from the consumer), approximately 70 tons of material is produced "upstream" from the consumer—in material extraction, production, and distribution—to replace the products being disposed.[1] When materials are discarded in a landfill, their upstream embodied energy is not recovered. Raw materials must be extracted from the earth to create new products. This leads to more energy use and GHG emissions in the following areas: resource extraction, product manufacturing, and transportation (upstream), as well as decomposition of compostables in landfills (downstream).

As methods of GHG accounting have advanced, new ways of understanding the extent of human-caused carbon emissions have emerged. Life cycle assessments (LCA) look at the emissions associated with the extraction, production, transportation, and disposal of the materials that make up our economy and food system. Seeking to better understand San Francisco's contribution to global GHG emissions, SF Environment worked with academic institutions (the University of California, Berkeley and the University of Colorado, Denver) and an independent international research organization (the Stockholm Environment Institute) to develop two alternative GHG inventories: the Trans-Boundary Infrastructure Footprint (TBIF) and the San Francisco Community Consumption-Based Emissions Inventory (CBEI).[2]



After buildings and automobiles, the food we consume is the third greatest source of GHG emissions. Local Live Power Farms community-supported agriculture baskets are one example of reducing those emissions.

TBIF is a hybrid of the traditional geographic inventory. It accounts for GHG emissions from energy used directly in buildings and road transportation in the city, purchased electricity used in the city, and then also includes life cycle GHG emissions from fuel supply, water supply, waste management, construction materials, and trans-boundary transport (road, air, and freight) serving cities.

The CBEI includes the GHG emissions associated with production, transport, sale, use, and disposal of goods and services consumed by San Franciscans. It does this by tracking local spending data and attributes GHG emissions to consumption (the end use or final purchase) of goods and services by government, businesses, and residents.

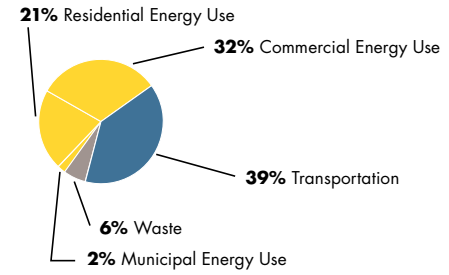
A comparative analysis of the data from these studies show:

- San Francisco's total carbon footprint from consumption is four times greater than that captured in the traditional inventory, 21.7 mT carbon dioxide equivalent (CO_2e) versus 5.7 mT CO_2e.
- Emissions generated from food consumed in San Francisco are 3rd in impact behind the manufacturing and operation of vehicles and buildings.
- San Francisco's overall transportation impact is lower than the national average, however,
- Air travel accounts for 11% of San Francisco's GHG emissions (compared with a global average of 3.5%).

These inventories provide a new framework for looking at emissions and although they are not used in conventional benchmarking and tracking of GHG emissions (and were not used in San Francisco's 2010 inventory), they reflect an alternative accounting of the impact of San Franciscans' consumption of goods, services, and key urban infrastructure materials on GHG emission levels. The City plans to reflect the findings of such alternative inventories in future reports, to help inform City purchasing, consumption patterns, and local economic development policies.

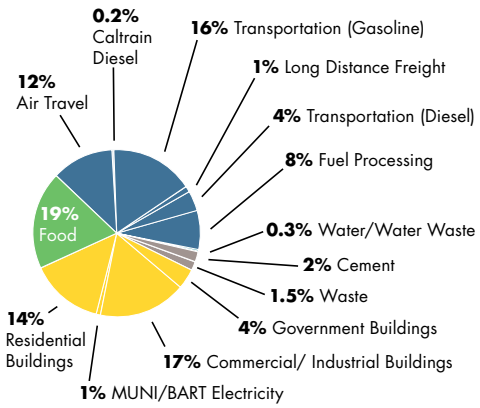
Figure 16. **2008 GHG inventories**

Traditional



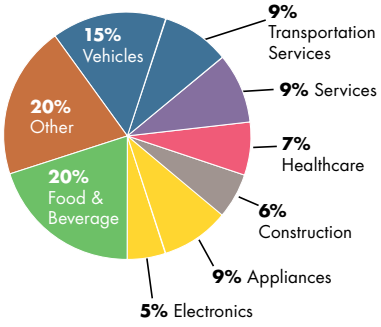
Total footprint: 5.7 MMT CO_2e

Geographic and Key Urban Materials (TBIF)



Total footprint: 10 MMT CO_2e

Consumption (CBEI)



Total footprint: 21.7 MMT CO_2e

Endnotes

[1] Fourth Assessment Report of the Intergovernmental Panel on Climate Change, Working Group I, Net Global Radiative Forcing, Global Warming Potentials and Patterns of Forcing, 2007

[2] Information on the University of California, Berkeley study can be found at: http://sfenvironment.org/download/household-consumption-inventories-bay-area- region

6 Urban Forest

Role in Greenhouse Gas Emissions

The city of San Francisco is graced with many parks, open green spaces, and large majestic tree species that thrive in our temperate, moisture-rich coastal climate. In addition to the beauty and the value it adds to our quality of life and real estate, our urban forest offers a multitude of environmental and health benefits, including the sequestration of carbon dioxide (CO_2). While the complex relationship between climate change and urban forests are still being studied, the City has data quantifying many of the ecosystem services and benefits. A 2007 study of the San Francisco urban forest determined that the city is home to approximately 700,000 trees. These trees collectively store 178,000 metric tons (mT) of carbon, and as they continue to grow, they sequester an additional 4,717 mT of carbon each year. This represents a reduction of 0.09% to our 2010 greenhouse gas (GHG) inventory. While this number may seem small, the city's urban forest is currently the only quantifiable mechanism that takes CO_2 directly out of the atmosphere. This sequestration—coupled with the health benefits, reduction of particulates (PM10), sulfur dioxide (SO_2), and ozone (O_3) by more than 9% during peak pollution hours, and the services urban trees provide by slowing and catching stormwater—makes the urban forest an important system in a thriving, well-functioning city.

Success Stories

Heron's Head Park

Launched: 1999

Goal: to increase access to open space for surrounding, underserved communities

Background: Heron's Head Park is a 23-acre restored wetland, owned by the Port of San Francisco and located at the base of the former Pacific Gas and Electric Hunters Point Power Plant. Once known as Pier 98, the park began in the early 1970s as an industrial-strength dumping ground along the Port of San Francisco's gritty southern waterfront. Now, it ranks among the nation's most unlikely natural habitat restorations.

After the industrial area was abandoned, nature took its course, and the landfill became critical habitat for more than 100 species of mostly migratory birds along the Pacific flyway and a variety of native and invasive plants—a hidden ecological treasure buried among forests of pampas grass, fennel, and California natives. By the early 1990s, the resulting salt marsh had become one of only two remaining wetland habitats in San Francisco. This was a tremendous asset; in the past 100 years, approximately 90% of the tidal wetlands had disappeared because of the advance of development and the creation of built environments through bay fill.

Local residents and teachers advocated for transforming the area into a park as a means to provide open space for surrounding, underserved communities. In the mid-1990s, the Port of San Francisco began a collaborative process to redevelop Pier 98. The project enhanced and expanded the marsh by removing over 5,000 tons of concrete, asphalt, metal, and other debris; created a tidal channel to improve circulation; and constructed upland trails, picnic and bird-viewing areas, and a fishing pier.

Thanks to the efforts of thousands of student and community volunteers (who planted natives, weeded out invasive species, and cleaned and maintained its wild areas), Heron's Head Park has become one of the most vibrant wetlands on the bay. In 1999, the former Pier 98 officially reopened to the public as Heron's Head Park, named for its resemblance when viewed from the air, to one of its residents: the great blue heron. The park is a story of reclamation success. It is used for education and recreation by thousands of walkers, birdwatchers, students, and visitors, and to support more than 100 bird species annually.

In 2010, after 10 years of planning, the EcoCenter at Heron's Head was opened. Nearly every feature of this 1,500 square foot facility is innovative and used to educate the public about renewable energy, pollution, GHG reduction, wastewater treatment, green building materials, and the green economy. It is San Francisco's first 100% "off-grid" building, piloting solar power and alternative wastewater technologies. Native landscaping promotes water conservation and the elimination of synthetic fertilizers and pesticides, and it also provides education around native plant propagation. The EcoCenter helps to further establish Heron's Head Park as an open space for residents to gather and socialize while learning about local plants and wildlife. It exemplifies the seamless integration of the built environment with park land and open space.

Heron's Head Park showcases a winning combination of public support and municipal investment.

Photo © Laura Sasso

The Blue Greenway, India Basin

Trends since 1990

Of the 700,000 trees in San Francisco's urban forest, more than half (about 60%) are on private land and outside of the City's jurisdiction. Approximately 40% are managed by various agencies within the municipal and county government. The public right-of-way along San Francisco's streets hosts about 105,000 (about 16%) trees, and 131,000 trees (or about 20% of the city's urban forest) are within the municipal park system, not including state and federal park lands.

Ongoing staffing losses and inability to fill open positions due to budget constraints have reduced public forest managers' ability to safely and effectively care for trees on public property, leading to declining health and canopy loss. Overall care of public trees and green space within public streets, streetscapes, and rights-of-way have been limited due to severe resource constraints. Meanwhile, the assumed average tree mortality rate of 3% to 4% per year exceeds San Francisco's current level of tree planting.

San Francisco's public lands are managed by several federal, state, and city agencies, often in collaboration with nonprofits, community organizations, and private property owners. The Recreation and Parks Department (RPD) manages a total of 3,400 acres, including natural areas, parks, community gardens, golf courses, and a large portion of the urban forest. The San Francisco Department of Public Works oversees street trees and urban forest within the public right-of-way, including landscaped medians, sidewalk gardens, Pavement to Parks, and Street Parks. The San Francisco Public Utilities Commission owns several natural areas, reservoirs, gardens, and significant stands of the urban forest. The Presidio Trust and the National Parks Service oversee significant tracts of open space. Along with these programs, many other City agencies (e.g., the Housing Authority, the Port, the Department of Public Health, and the Municipal Transportation Agency) and state entities (State Parks and the University of California) also own and oversee significant tracts of open land, including natural areas and urban forests.

Table 12. **SF Urban Forest Bases, 2008**

Feature	Measure
Number of Trees	669,000
Tree Cover	11.9%
Most Common Species	Blue Gum eucalyptus Monterey pine Monterey cypress
Pct of Trees < 6" diameter	51.5%
Pollution Removal	236 mT/yr ($1.3 million/yr)
Carbon Storage	177,808 mT ($3.6 million)
Carbon Sequestration	4,717 mT/yr ($95,000/yr)
Structural Value	$1.7 billion

Despite the challenges of funding and fractured management jurisdiction, San Francisco has been able to enact several key policies and programs to improve urban forest management:

- The Adopted Pruning Standards, based on the International Society of Arboriculture and American National Standards Institute, provide guidelines on how to prune trees for improved health and structure that anyone working on public trees must adhere to. San Francisco Department of the Environment (SF Environment) developed a Pruning Standards booklet to help community members understand these standards and improve the care they provide to trees.
- The Landmark Tree program identifies and protects San Francisco's best trees, preserving them for as long as they are healthy and structurally sound.

Photo: ©Laura Sasso

- RPD has implemented the Tree Management Plan for the Park Forestry program. Funded in part by the Clean and Safe Neighborhood Parks bond, this program completed a comprehensive prioritization of RPD trees, taking into account tree health and location, identifying safety concerns, and creating solutions to address them on a site-by-site basis for physical improvement of the urban forest.
- Additional urban forest policy improvements include the adopted Green Landscaping Ordinance, which strengthens greening requirements associated with new development, and the forthcoming updates to the Recreation and Open Space Element, which creates a framework for open space in San Francisco.
- The Green Connections program, led by the Planning Department, is an effort to identify opportunities for community greening that improves pedestrian and bicycle access to community amenities and recreational opportunities while supporting wildlife habitat.

San Francisco has also seen success increasing green space through the sidewalk landscaping and Street Parks program. As these spaces are generally planted and maintained by individuals, increasing education and outreach in appropriate plant selection to support biodiversity and discouraging the use of invasive species is critical. The main focus in this area is the implementation of multimodal streetscape enhancements to increase street-side greening opportunities. These enhancements increase the benefits of permeable sidewalk landscaping, can help reduce loss of street trees due to infrastructure spacing requirements, and provide vital social and economic benefits.

Success Stories

San Francisco Urban Orchard Project

Launched: 2011

Goal: to increase number of urban street trees

Background: The San Francisco Urban Orchard Project was developed in partnership with SF Environment's Urban Forestry and Carbon Fund programs. Launched in 2009, the San Francisco Carbon Fund (SF Carbon Fund) is the nation's first truly local carbon offset program. It helps the City to achieve its ambitious climate targets. The SF Carbon Fund makes investments to mitigate GHG emissions from visitor, business, resident, and city government activities—air travel, auto use, hotel stays. The Urban Orchard Project works with local nonprofit organizations to plant and maintain fruit and nut tree orchards in several locations throughout San Francisco.

In 2011, the "Gray to Green" Advisory Panel to the San Francisco Climate Action Plan recommended that the City support the activities of neighborhood and community groups in their roles as local stewards of urban forest. The Urban Orchard Project fulfills this mandate. For example, in late 2012, the group Friends of the Urban Forest was awarded a grant by the project to plant and provide care for 200 apple, pear, and plum trees, planted in January 2013. This stripe of urban agriculture satisfies multiple goals—expands the urban forest, supports locally available free food production, stimulates people's interest in fruit trees and their care, and provides the opportunity for green job skills training. Through the Urban Orchard Project, trees are made available to property owners, community organizations, and City agencies to plant on both private and public land.

Spring fruit tree planting with the SF Carbon Fund.

Urban trees provide valuable environmental benefits. Trees planted through the project are expected to absorb and sequester upwards of 150 mT of CO_2 over 15 years. They also will increase shade and canopy cover, aid stormwater retention, and improve local air quality. Fruit and nut trees are particularly good for urban food production because they are adaptable and can be grown in sloping areas where it would be expensive to build raised beds for vegetables. Although they require annual pruning, fertilizing, and harvesting, they also are less labor intensive once established and they tend to be much easier to care for than vegetables.

These trees also may provide a crucial buffer between eaters and the kinds of toxic compounds that exist in urban soils. In a University of California, Davis study of almonds grown in soil known to have very high level of contaminants, the nuts were found to be completely contaminant-free and safe for consumption.

The project is maintained by the San Francisco Housing Authority, which hires and trains residents in maintenance, harvesting, and distribution of the bounty provided by its orchards to residents and local schools. Around a half dozen urban gardening groups and organizations have taken advantage of the project. According to SF Environment, urban food planning is a way to prepare for disasters by making sure food is available in the city.

Photo: © Chris Carlsson

Strategies to Reduce Emissions

The urban forest's annual carbon sequestration will decline without further investment. Before plans to increase the size of the City's urban forest are initiated, long-term stable funding mechanisms to maintain existing public land trees must be identified. Once funding for existing maintenance is in place and our existing forestry resource is stabilized, San Francisco's long-term goal is to expand the tree canopy cover from the current 11.9% to 25%. While this work is pursued, San Francisco will continue to support private individuals and institutions in the care of their trees and open spaces with low-cost strategies and by engaging the support of the general public and private sector.

Identify stable long-term funding mechanisms to support existing trees

Resources and staffing to support public forestry programs have been in constant decline, while the management needs of the maturing forest have increased. The most important goal to improve forestry function and health is identification of stable, long-term funding to increase programmed forestry management activities, properly address public safety hazards before they cause harm, and reduce loss of trees due to benign neglect.

Examples of successful funding mechanisms include the 2008 and 2012 Neighborhood Parks Bonds, through which RPD was able to perform risk assessment, create an action plan, and address hazard trees. Business improvement and community benefit districts regularly include urban forest management in their scope of work; these voluntarily formed organizations have planted and provided care for trees within many significant business corridors, including Union Square and the Noe Valley 24th Street corridor. Parcel taxes for maintenance of trees in the public right-of-way and the sidewalk around them could result in an overall lower cost to property owners while reducing hazards and improving quality of life.

Increase San Francisco's canopy cover to 25% by 2030

When stable, long-term funding for public forestry programs has been achieved, and these programs have been able to increase overall management and planting levels to stabilize the existing forestry resource, San Francisco will pursue increasing the canopy coverage to 25%. In support of this goal and overall urban forestry management, the San Francisco Planning Department and the Department of Public Works are preparing an Urban Forest Plan. The Plan will identify policies and strategies to proactively manage and

grow the city's street tree population, increasing the urban forest resource and associated carbon storage, stormwater management, and other environmental services. The central structural goal expected from this plan is to expand canopy cover in San Francisco to 25%, including a 50% increase in street tree canopy.

Support a robust community stewardship network

Many city agencies have developed innovative mechanisms to include the community in urban forest oversight. The Street Parks program transforms vacant lots into gardens, trash and illegal dumping spots into greenery, and hillsides into parks. Since its inception in 2004, 100 community gardens have been developed and many more are in progress. San Francisco's Pavement to Parks Program facilitates the conversion of under used spaces in the street, repurposing them into spaces for people. Merchants, community organizations, business owners, and residents apply for, design, install, and maintain these mini-parks, which provide aesthetic enhancements to the streetscape and an economical solution to the need for increased public open space. Increasing education and outreach to support the businesses, community groups, nonprofits, and individuals in site design and oversight supports biodiversity and reduces the use of invasive plants.

For neighborhood groups, schools, and other local organizations interested in planting trees and greening their public spaces, SF Environment administers a microgrant program through the San Francisco Carbon Fund. This funding, financed by a fee on City employee travel, makes small grants for urban forestry projects and other urban greening initiatives. For example, the Urban Orchard Project plants fruit trees on publicly accessible land through partnerships with community-based organizations.

There are many opportunities to support retention and care of trees and green spaces on private property as well, especially in the realm of education and outreach. The City's Landmark Tree program is able to protect exceptional trees anywhere in the city, including on privately owned property; increasing program participation will conserve standing carbon resources. By providing education and resources, such as compost, seeds, and fruit trees, San Francisco can increase backyard food-productive gardening and the availability of locally grown food, and address unmet need for public community garden space.

Emission Reduction Opportunities to 2030

If existing trees are maintained, the city's urban forest will continue to sequester just under 5,000 tons annually. Assuming an additional 50,000 trees are planted between 2017 and 2030, the estimated amount needed in order to expand canopy cover to 25%, the urban forest is expected to sequester an additional 15,600 tons annually. Caring for the existing forest and expanding the urban canopy will play an important role in balancing the impacts of the pollution produced elsewhere, making the city healthier and more climate friendly. Fundamentally, trees are a valuable part of the public infrastructure, providing clean and healthy air, shade and cooling, and stormwater diversion. Gaining a better understanding and creating robust management and expansion of the urban forest and other green spaces will be essential for both climate mitigation and adaptation.

Endnotes

[1] 2006, Urban Forest Effects Study, on SF Environment, http://www.sfenvironment.org.

[2] U.S. Department of Agriculture, San Francisco's Urban Forest: Assessing Urban Forest Effects and Values, 2007.

[3] http://www.spur.org/blog/2012-11-06/financing-urban-forest

[4] Recreation and Open Space Element, Revised Draft, San Francisco General Plan, 2011

[5] Draft Urban Forest Master Plan Outline June 2013.

Compost giveaway at "Please Touch" community garden.

7 Municipal Operations

Contribution to Greenhouse Gas Emissions

As of 2010 just under 4% of San Francisco's greenhouse gas (GHG) emissions were generated by energy consumed in municipal government buildings and fleet vehicles, including health services (San Francisco General Hospital, Laguna Honda, and neighborhood clinics), safety and emergency services (police, fire protection, and emergency entities), public works maintenance (roadways and parks), airport and port operations, parks and recreation, San Francisco Municipal Railway (Muni) buses, and light rail. Between 1990 and 2010 the city government reduced emissions in these areas by 25,870 metric tons (mT) of carbon dioxide equivalent (CO_2e).[1] Emissions are projected to fall even further as the San Francisco Public Utilities Commission began providing 100% carbon-free electricity to all municipal buildings in Fiscal Years 2011–2012.

Compared to other municipalities of its size, San Francisco's emissions from government operations are relatively low, primarily because of its ownership and operation of the Hetch Hetchy Water and Power system that historically has provided very low-carbon electricity. As of 2011, Hetch Hetchy has been providing only carbon-free electricity, which powers all municipal buildings, water treatment plants, and rail cars. The water system itself has a very low energy profile, reflecting its gravity-fed design. The largest GHG emission sources for San Francisco municipal operations are natural gas for buildings and diesel for Muni buses.

In 2005 the City and County of San Francisco began voluntarily reporting its operational carbon footprint to the California Climate Action Registry. In 2008 at the direction of the Board of Supervisors Ordinance 81-08, the City took an even more detailed inventory of our emissions, bringing carbon accounting down to the department level. Reporting to the California Climate Action Registry was ceased due to the more detailed level of accounting required by Ordinance 81-08. Since 2008 every City department reports its environmental requirements and carbon footprint in an annual Departmental Climate Action Plan (DepCAP).

Success Stories

Department Collaboration for Sustainability and Operational Efficiency: Paperless Paychecks

Launched: 2010

Goals: reduce GHG emissions and conserve resources

Metrics: total annual amount of paper used

Background: In 2010, the Controller's Office and the San Francisco Department of Human Resources rolled out a program to reduce the amount of paper waste produced through the payroll process. Even with 89% of the City's workforce participating in direct deposits, the City still was using nearly two million pieces of paper and envelopes each year to deliver biweekly pay stub confirmations. The program requires new employees to participate in the paperless paycheck system.

The City also has been successful in enlisting local vendors to participate in direct deposits, effectively reducing the amount of paper that is used to print paper checks. Vendors

Photo: @AECOM

SF Fire Department fleet includes many hybrid vehicles. Under City ordinance, all City departments must increase the fuel efficiency of their fleet.

Emissions from municipal energy use and Muni buses decreased

1990 ⋮ 25,890

2012 ↓ mT CO_2e

are encouraged to submit invoices online, and vendor payment checks are printed weekly instead of daily (the standard before the program started).

Although achieving participation in resource conservation is difficult at times, the Controller's Office and the Department of Human Resources have made great strides in instituting a cultural change—one example of how City departments have contributed to making San Francisco more sustainable by institutionalizing green practices.

Results

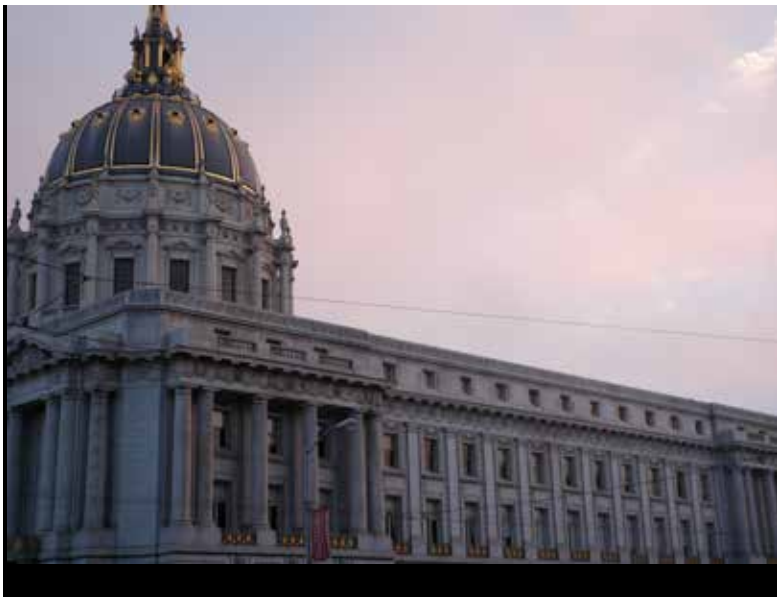
The collaborative effort of the Controller's Office and the San Francisco Department of Human Resources has

- set a benchmark for resource conservation in changing traditional business practices; and
- reduced paper, contributing to a lessened carbon footprint.

Website: **sfcontroller.org/index.aspx?page=88**

Trends since 1990

Based on the 2010 Community-Wide GHG Inventory, emissions from municipal operations have decreased 25,870 mT CO_2e since 1990. Similar to the commercial and residential sectors, this emissions decrease is due to an increasingly clean supply of electricity. Consumption of electricity in municipal facilities has increased 11% and consumption of natural gas has increased 254%. Emissions from diesel used in Muni buses have decreased since 1990. This decrease is due to both an increase in the use of less carbon-intensive biodiesel and an 18% reduction in total gallons of diesel consumed.



Success Stories

Community Outreach and Education: Juvenile Probation Community Gardens

Launched: 2010

Goal: change the lives of incarcerated juveniles

Metrics: number of youth participating in the program

Background: The San Francisco Juvenile Probation Department has gone well beyond its DepCAP commitments by helping reduce environmental impacts at the community level. It is integrating environmental education and training in its youth programs—in San Francisco neighborhoods as well as at its Log Cabin Ranch in

San Mateo County. The Log Cabin Kitchen Gardening Project introduces youth to gardening and food concepts that are sustainable and environmentally friendly. Youth grow organic fruits and vegetables in their garden and learn horticulture skills. Through learning how to harvest and cook this healthy produce, they learn about nutrition and the environmental impacts of agriculture and food production.

The Juvenile Probation Department also partners with the San Francisco Conservation Corps to implement project-based learning that focuses on employment opportunities in the green sector. Students participate in capital improvement projects that incorporate green features as well as other projects that are specific to the vast expense of green open space surrounding the Log Cabin Ranch. The Juvenile Probation Department's programs on green building, food, and the environment have a lasting impact on youth as they re-enter the community.

Results

The San Francisco Juvenile Probation Department has

- implemented waste reduction strategies including promotion of an electronic case management system for probation officers, scrap metal and cardboard recycling, increasing composting efforts, and use of a virtual warehouse for supplies, among others;
- encouraged its employees to carpool to and from work, reducing enrollment in commuter benefits from 80 staff in 2010 to 73 staff in 2011;
- as of October 2011, helped 80 youths, showed a 100% operating recidivism rate for Log Cabin Ranch graduates, witnessed 86% of graduates employed within 60 days of release, seen 100% of its graduates enrolled in a school or vocational program on release, and had 93% of its graduates engaged in some form of community support service on release; and
- improved the outcome for juvenile offenders and reduced the potential for migration into the adult prison system.

Website: **sfenvironment.org/sites/default/files/**

Emission Reduction Opportunities to 2030

The City of San Francisco's 2010 carbon footprint is dominated by GHG emissions from natural gas and diesel consumption. Because emissions from electricity, the third largest source, will move to zero as the San Francisco Public Utilities Commission provides City departments with carbon-free Hetch Hetchy power, future GHG emissions reduction strategies will focus on building energy efficiency, fuels, and fleet vehicles.

Although increased fuel efficiency remains an ever-present priority, SFMTA's diesel consumption will most likely increase as the agency expands its services to meet transportation demands. Major GHG emissions reductions in diesel consumption will be realized by substituting fossil-based fuel with environmentally appropriate biofuels. In particular, increasing the blend of biodiesel used in Muni buses to B50 in 2020 and B100 in 2035 has been estimated to be the single largest step the City can take to reduce its carbon footprint, avoiding 22,369 and 77,002 mT GHGs, respectively.

San Francisco City Employees can use Muni tokens or check out a bike from the City Cycle Program for work trips.

Success Stories

Helping Hands, Innovation in Materials Management: San Francisco Animal Care and Control & San Francisco Public Library Newspapers

Launched: 2013

Goal: help City departments save resources

Metrics: numbers of newspapers recycled

Background: Some unusual and creative collaborations have resulted from departmental participation in the DepCAP process. For example, the San Francisco Public Library is partnering with San Francisco Animal Care and Control (ACC) to implement an alternative method of recycling the its old newspapers. The main branch of the library was recycling about 2,000 newspapers each month (enough to fill two full-sized recycling bins), while ACC was purchasing materials to line animal cages when their stock of donated newspaper ran low. Climate Liaisons from both departments were connected through the DepCAP Program and promoted having the library donate its recyclable newspapers to ACC. ACC was able to realize a consistent, monthly supply of newspapers, without relying on volunteer donations or using scarce budget resources to purchase supplies.

The diversion of newspaper from recycling to animal care is a unique method of resource conservation within the City. As an added bonus, this solution allows both departments to save money because a need no longer exists for the purchase and disposal of newspaper. This is an excellent example of how City departments can work together to find creative, and often simple, solutions.

Results

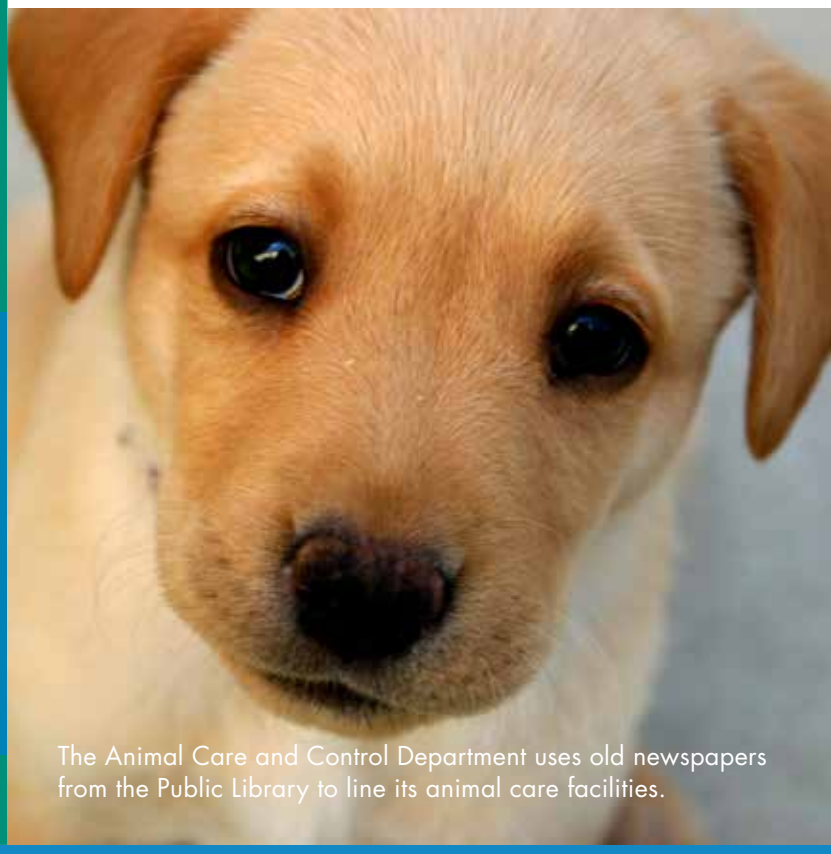
By partnering together, San Francisco ACC and the San Francisco Public Library have

- pooled their resources for a unique solution to recycling and
- helped save City budget while promoting animal welfare.

Website: **sfenvironment.org/news/update/library-newspapers-help-san-franciscos-furry-friends**

Departmental Climate Action Planning

The Climate Team at the San Francisco Department of the Environment (SF Environment) runs the DepCAP program, an annual program that serves as outreach, education, and monitoring for the City's carbon footprint and other sustainability policies and programs. Starting each fall the Climate Team provides city agencies, via internally appointed Climate Liaisons and other city employees, education on existing and new environmental policies, specifications for the submittal of the DepCAP, and assistance with the report. The spring months are dedicated to reviewing the submitted plans, and each department is given a personalized scorecard that reflects compliance and participation in all required areas. Spring and summer are also used to plan and host the Mayor's Annual Green & Blue Awards, an internal awards ceremony where outstanding departments are recognized for their work. The summer months are spent on data roll-up and program planning for the following year's DepCAP process. Data gathering and processing happens throughout the year to compile department-level building energy, vehicle fuel, and water use data, and associated GHG emissions.



The Animal Care and Control Department uses old newspapers from the Public Library to line its animal care facilities.

Success Stories

Institutionalizing Sustainability: Departmental Climate Action Plans

Launched: 2008

Goal: reduce GHG emissions from municipal operations

Metrics: number of Departmental Climate Action Plans (DepCAP) produced

Background: SF Environment works with more than 50 City departments to develop and implement their individual DepCAPs. These plans require departments to report on their energy and water consumption, fleet information, green purchasing records, and City staff behavior change and education programs, as well as on their commitments to reducing the department's overall carbon footprint. This informs the City's overall climate action strategy, as each department recognizes its share in achieving GHG emissions reduction goals.

The DepCAP program is made possible by SF Environment's Climate Liaisons; individuals who volunteered or were designated the task of helping to produce the annually required climate action plan for each City department. The program provides an avenue for environmental leaders throughout the city to learn from each other and develop relationships that lead to innovative actions and high impact initiatives.

The Climate Liaisons have taken on the demanding task of coordinating department climate action commitments in addition to their regular jobs. They are recognized each spring at the annual Green & Blue Awards ceremony, where whole departments and individual staff members are commended for their important work.

With all City departments in alignment regarding GHG emissions reduction, San Francisco is working effectively to progressively reduce its citywide impact on the environment.

Results

The DepCAP program has

- more than 50 City departments participating and
- fostered 39 DepCAPs, representing 54 departments.

Website: **sfenvironment.org/article/city-government-climate-action/city-department-climate-action-planning-0**

Recipients of the 2011 Greatest National Impact Award with EDF

2011 Green & Blue Award presenters

Endnotes

[1] San Francisco 2010 Community-Wide GHG Inventory, City and County of San Francisco. SF Environment Climate Team. 3rd Party Verified, ICF International, April 10, 2012.

A Glossary & Abbreviations

ACC	San Francisco Animal Care and Control
BART	Bay Area Rapid Transit
CBEI	Consumption-Based Emissions Inventory
City	City of San Francisco
CO_2	Carbon dioxide. A colorless, odorless, nonpoisonous gas that is a normal part of air. Of the six greenhouse gases normally targeted, CO_2 contributes the most to human-induced global warming. CO_2 is the standard used to determine the"global warming potentials" of other gases.
CO_2e	Carbon dioxide equivalent. The emissions of a gas, by weight, multiplied by its global warming potential. CO_2e is used to compare the relative climate impact of different greenhouse gases. CO_2e allows reporting of greenhouse gas emissions in one standardized value and aids comparison of emissions generation or reduction.
degree days	A calculation used to estimate heating and cooling costs. Heating degree days is the annual sum of the degrees above 68 for each day's average temperature. Cooling degree days is the annual sum of the degrees below 68 for each day's average temperature. If there is a predominance of one type of degree day over another; that indicates either a very hot or very cold environment. If both numbers are large, that generally indicates a very variable climate. If both numbers are small, that generally indicates a more consistent climate.
DepCAP	Departmental Climate Action Plan
EV	electric vehicles
GHG	greenhouse gas
kilowatt hours	unit of energy, number of kilowatts multiplied by number of hours
LEED	Leadership in Energy and Environmental Design
MMT	million metric tons
mT	metric tons
Muni	San Francisco Municipal Railway
MW	megawatt (unit of power equal to one million watts)
MWh	megawatt hours
NEM	Net Energy Metering (billing arrangement that provides customers with renewable distributed generation with credit for their system)
O_3	ozone
PG&E	Pacific Gas and Electric Company
PM10	particulate matter smaller than 10 microns diameter
RPD	San Francisco Recreation and Parks Department
RPS	Renewables Portfolio Standard
SF Environment	San Francisco Department of the Environment
SFMTA	San Francisco Municipal Transportation Agency
SFPUC	San Francisco Public Utilities Commission
sharrow	a shared-lane street marking, placed at the center of a travel lane to indicate that bikers can use the full lane
SO_2	sulfur dioxide
SPUR	San Francisco Planning and Urban Research Association
TBIF	Trans-Boundary Infrastructure Footprint
therm	unit of heat energy equal to 100,000 British thermal units
VMT	vehicle miles traveled
virtual net metering	allocating the credit from one renewable energy system across multiple accounts without electrical hardwiring
ZNE	zero net energy

B Resource List

LOCAL CLIMATE IMPACTS REPORTS

Anticipated climate impacts are taken from a report synthesizing San Francisco Bay Area–focused findings from research conducted between 2010 and 2012 as part of the state's vulnerability and adaptation study sponsored by the California Energy Commission's Public Interest Energy Research (PIER) Program.

Ekstrom, Julia A., and Susanne C. Moser. 2012. Climate Change Impacts, Vulnerabilities, and Adaptation in the San Francisco Bay Area: A Synthesis of PIER Program Reports and Other Relevant Research. California Energy Commission. Publication number: CEC-500-2012-071.

ENERGY REPORTS

The San Francisco 2011 Updated Electricity Resource Plan sets a goal of delivering 100% carbon-free electricity to all San Franciscans.

San Francisco Public Utilities Commission. 2011. San Francisco's 2011 Updated Electricity Resource Plan: Achieving San Francisco's Vision for Greenhouse Gas–Free Electricity. March.

Energy efficiency strategies and pathways to achieving 100% renewable energy within the next 10 years are taken from the Mayor's Renewable Energy Taskforce Report.

San Francisco Mayor's Renewable Energy Task Force Recommendations Report. 2012. San Francisco Department of the Environment, sponsorship from the Sidney E. Frank Foundation.

Green building codes and LEED standards for new buildings are taken from the Mayors Taskforce Report on Green Building.

The Mayors Taskforce on Green Building for the City and County of San Francisco Report and Recommendations. 2007. Department of Environment.

Estimates for efficiency gains in commercial building of buildings 50% by 2030, or an average net reduction of 2.5% per year were taken from the Mayors Taskforce Report on Existing Buildings.

San Francisco Mayors Taskforce on Existing Commercial Buildings. 2009. Department of the Environment.

The California Long-Term Energy Efficiency Plan was used for reference to Net Zero Energy Building goals for new (and some existing) residential buildings by 2020 and commercial buildings by 2030.

California Long-Term Energy Efficiency Strategic Plan (CEESP).

TRANSPORTATION REPORTS

All VMT reduction goals and GHG calculations for all demand management, congestion pricing Muni strategies were developed in concert with and taken from the SFMTA Sustainable Streets Division with support from the San Francisco County Transportation Authority.

The San Francisco Municipal Transportation Agency Climate Action Strategy. 2011.

Goals on bicycle infrastructure, safety and accessibility are taken from the San Francisco Bike Plan, a subset to the SFMTA's Transit First policy as well as the City's 2004 Climate Action Plan.

San Francisco Bike Plan. 2012. San Francisco Municipal Transportation Agency.

The California Long-Term Energy Efficiency Plan was used for reference to Net Zero Energy Building goals for new (and some existing) residential buildings by 2020 and commercial buildings by 2030.

California Long-Term Energy Efficiency Strategic Plan (CEESP).

ZERO WASTE REPORTS

Trans-Boundary Infrastructure Study includes for GHG emissions from: energy used directly in buildings and road transportation in the city, purchased electricity used in the city, and life-cycle GHG emissions from fuel supply, water supply, waste management, construction materials, and trans-boundary transport (road, air, freight) serving cities.

TBIF Summary-City and County of San Francisco. Ramaswami, A., Hillman, T., Janson, B.; Reiner, M.; Thomas, G, "A Demand-Centered Hybrid Life Cycle Methodology for City-Scale Greenhouse Gas Inventories", Environmental Science & Technology, 2008, 42(17): 6456 – 6461."

Information on the carbon footprint by dollars spent on goods and services in San Francisco comes from the Consumption-Based Emissions Inventory for San Francisco.

Estimates of the Greenhouse Gases Released to Produce, Transport, Sell, Use, and Dispose of Goods and Services Consumed in San Francisco. Stanton, E.A, Bueno, R., Cegan, J, and Munitz, C. (2011). Consumption-Based Emissions Inventory for San Francisco: Technical Report. Somerville, MA: Stockholm Environment Institute U.S. Center. sei-us.org

URBAN FOREST REPORTS

Analysis of the urban forest and its carbon sequestration values are taken from a USDA Forest Service Report and used the UFORE Urban Forest Effects Model.

Nowak, David J., Robert E. Hoehn III, Daniel E. Crane, Jack C. Stevens, and Jeffrey T. Walton. 2007. San Francisco's Urban Forest: Assessing Urban Forest Effects and Values. Resource Bulletin, NRS-8. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station.

Recommendations on future actions to care for and increase the size of San Francisco's Urban Forest are taken from the 2010-2011 San Francisco Urban Forest Council Annual Report.

San Francisco Urban Forest 2011 Annual Report. Department of the Environment.

C Climate Action History

1996

The City of San Francisco publishes its first Sustainability Plan

Under Mayor Frank Jordan, the San Francisco Board of Supervisors created the Commission on the Environment in 1993, charging it with developing a Sustainability Plan for San Francisco. A citywide effort—involving hundreds of San Franciscans—culminates in the publication of the City's Sustainability Plan in 1996 and its adoption by the Board of Supervisors in 1997.

2002

The U.S. leads negotiations on the Kyoto Protocol but then does not sign the agreement

The Kyoto Protocol is an international agreement, linked to the U.N. Framework Convention on Climate Change. It sets binding targets for 37 industrialized countries and the European community for reducing GHG emissions. The United States is one of the key negotiators of the protocols. However, in 2003, the Senate fails to ratify Kyoto commitments.

California adopts the first Renewables Portfolio Standard, requiring 20% of all electricity to be from renewable resources

The Renewables Portfolio Standard requires that 20% of all power delivered by PG&E, the City's primary power provider, come from eligible renewable resources. The percentage was raised to 30% in 2008; and then was raised again the same year to 33% by 2020.

The San Francisco Board of Supervisors adopts a Zero Waste goal for 2020 and 75% diversion from landfill goal for 2010

The "fantastic three" blue, green, and black bins are rolled out, accompanied by citizen education and outreach.

The San Francisco Board of Supervisors adopts the Electricity Resources Plan and develops plans to close Hunters Point and Potrero power plants

The Electricity Resources Plan creates a road map for the shutdown of Hunters Point and Potrero power plants, electricity transmission upgrades, and a focus on renewable energy and conservation.

The San Francisco Board of Supervisors passes Resolution 15-02

Resolution 15-02 calls for the City to develop a plan to reduce GHG emissions.

2003

The San Francisco Department of Environment establishes the San Francisco Municipal Environmental Code, codifying key environmental policies

The Environment Code was developed to consolidate the City's ordinances governing protection of the environment, natural resources, and sustainability that were previously scattered throughout the Administrative Code.

2004

The City of San Francisco publishes its first Climate Action Plan

Under Mayor Gavin Newsom, the San Francisco Department of Environment publishes one of the first community climate action plans in the United States as part of its commitment to the U.S. Conference of Mayors' Climate Protection Agreement. The aggressive goals and detailed actions prescribed by the Climate Action Plan for San Francisco breaks ground in the American climate policy movement, establishing San Francisco as a national leader in city-driven climate action. The plan includes an inventory of emissions from the built environment and transportation sector, and a suite of actions to reduce emissions from these sectors and emissions generated by landfill waste. Over the following seven years, the community GHG inventory is twice updated, each time with more detailed data, creating an increasingly accurate summary of the city's carbon footprint. In the San Francisco Environment Code, Chapter 9, Greenhouse Gas Goals and Departmental Climate Action Plans, the City is committed to reducing GHG emissions: 20% below 1990 levels by the end of 2012, 25% below 1990 levels by the end of 2017, 40% below 1990 levels by the end of 2025, and 80% below 1990 levels by the end of 2050.

2005

The U.S. Conference of Mayors commits to the goals of the Kyoto Protocol

When the U.S. Senate failed to ratify the Kyoto Protocol in 2003, the U.S. Conference of Mayors, led by then-Seattle mayor Greg Nichols, created the Mayors Climate Protection Agreement, which acknowledges the need to fight climate change and support the Kyoto emissions reduction targets. In 2005, the Mayors Conference formally endorses the agreement. Mayor Newsom signs the agreement, committing San Francisco.

The U.N. Urban Environmental Accords is hosted by San Francisco

San Francisco hosts U.N. World Environment Day, during which Mayor Gavin Newsom presents mayors from around the world with a unique opportunity to create a set of objectives for an urban future that will be "ecologically sustainable, economically dynamic, and socially equitable." Based on existing best practices and applied to issues like energy, waste reduction, urban nature, transportation, and water, the Urban Environmental Accords have since been signed by more than a hundred mayors, who have begun applying accord principles in their own cities across the globe. Since that time, San Francisco has been adopting three Urban Environmental Accords actions per year.

2006

Hunters Point Power Plant is closed, representing a major environmental justice victory

San Francisco meets the Electricity Resource Plan goal of closing Hunters Point, a dirty, polluting power plant, achieving a major environmental justice victory.

California passes Assembly Bill 32, the Global Warming Solutions Act

The Legislature passes and Governor Arnold Schwarzenegger signs Assembly Bill 32, the Global Warming Solutions Act of 2006, which establishes a goal to reduce statewide GHG emissions to 1990 levels by 2020. Assembly Bill 32 directs the California Air Resources Board to set rules and standards to produce emissions reductions statewide, including the establishment of a cap-and-trade program for the state's largest emitters.

2007

San Francisco amends the Municipal Environment Code, adding Chapter 9, Greenhouse Gas Emissions

This chapter summarizes all climate-related policies, mandates, and reporting requirements for the City and County of San Francisco and the community at large.

San Francisco Public Utilities Commission hosts the first Water Utility Climate Change summit

In January, the San Francisco Public Utilities Commission initiates this national summit to discuss the effects of climate change on the fresh water supply. The conference is attended by a wide range of government officials, environmentalists, and experts in water supply and wastewater. Following the summit, the Water Utility Climate Alliance is formed, a leadership group that seeks to protect and manage the water supply in the face of climate change.

The City of San Francisco bans plastic bags at large grocery stores and retailers and Styrofoam containers in restaurants and hotels

One million littered plastic bags enter San Francisco Bay each year. Disposable plastic bags often contaminate recyclable and compostable waste streams and obstruct waste sorting equipment. Strengthened in 2012, this remains the nation's most extensive bag ban.

The City of San Francisco makes LEED Silver certification mandatory for all new commercial buildings

LEED certification is a rating system for green solutions to a building's design, construction, operations, and maintenance. In 2007, the City requires all new commercial buildings to attain LEED Silver certification. By 2012, all new buildings must adhere to LEED Gold standards.

The Business Council on Climate Change is launched, fulfilling one of San Francisco's primary commitments to the Urban Environmental Accords

In response to a commitment made by the private and public sector at the U.N.'s Global Compact, a consortium of Bay Area business leaders establish the Business Council on Climate Change, BC3, a unique public-private partnership committed to reducing GHG emissions. BC3 endorses the Principles on Climate Leadership, a strategic framework to address climate change as well as a forum for sharing best practices. In addition, the Principles create a model for climate action in the public and private spheres that the U.N. Global Compact can share with other businesses and cities around the world.

2007

The San Francisco Bay Area State of the Urban Forest report is released, documenting the environmental and financial benefits of San Francisco's trees

Produced for the city and Bay Area by a department of the U.S. Forest Service, the report quantifies the value of ecosystem benefits provided by the city's trees. Trees are an important asset to the city because they absorb carbon and other harmful pollutants. As a result of the report, the San Francisco Urban Forest Council is created to manage resources for the city's urban forest.

California's Senate Bill 97 passes, directing the California Natural Resources Agency to include GHG impacts in the California Environmental Quality Act Guidelines

The bill marks the first occasion that the State has acknowledged that GHG impacts should be included in a legal assessment of environmental impacts.

2008

California's Renewables Portfolio Standard is raised to 33%

Governor Arnold Schwarzenegger signs Executive Order S-14-08, requiring that all retail sellers of electricity must serve 33% of their load with renewable energy by 2020. The bill was first established in 2002, and was accelerated in 2006.

A Governor's Executive Order directs state agencies to prepare a California climate adaptation strategy

This Executive Order formally acknowledges that climate change possesses significant risks to California's citizens, ecosystems, and economy, and directs State agencies to prepare a State of California Climate Adaptation Strategy.

The San Francisco Board of Supervisors adopts Ordinance No. 81-08, the Climate Change Goals and Action Plan, mandating the reduction of GHG emissions by each City department

In 2008, all City and County of San Francisco departments began annual reporting on their carbon footprints via Departmental Climate Action Plans (DepCAP). This program was mandated by the Board of Supervisors Ordinance 81-08 and is managed by the San Francisco Department of Environment; all DepCAPs can be found on the department's website.

The San Francisco Planning and Urban Research Association publishes its Critical Cooling report, detailing cost-effective climate actions

The San Francisco Planning and Urban Research Association issues a policy paper, Critical Cooling that asks the important question: among so many carbon-reduction opportunities, how do we prioritize? The paper includes a cost-benefit analysis that leads to recommendations for the most significant, cost-effective ways for San Francisco to reduce GHG emissions. The report also calls for mandates and funding, pointing out that without them, a city cannot implement even the best ideas.

The City of San Francisco meets Kyoto Protocol targets, reducing its carbon footprint to 7% below 1990 levels

The City reassesses its emissions inventory mainly because of the closure of Hunters Point and an increase in renewable energy use; emissions have decreased by 7%, slightly besting Kyoto targets.

2009

California's Clean Car Standards go into effect, requiring increased gas mileage for automobiles

Assembly Bill 1493, the Pavley bill, is the first law in the nation to address GHG emissions from passenger cars. In 2002, the California State Legislature passes the bill, and in 2004, the California Air Resources Board adopts the mandated standards. The law also requires car manufacturers to achieve significant emissions reductions in their fleets by 2016. Seven other states have pledged to adopt California's standards.

The San Francisco Board of Supervisors passes the Mandatory Composting and Recycling Ordinance, and the City of San Francisco achieves its 75% waste diversion goal one year early

Passed by the Board of Supervisors in June 2009, this ordinance requires all San Franciscans, both residents and businesses, to separate recyclables and compostables from landfill trash.

2010

Key federal climate legislation, the U.S. Cap and Trade Bill, is defeated

The American Clean Energy and Security Act is a federal bill that would have put a cap on the quantity of emissions a business is allowed to emit, while also providing carbon offsets that companies could buy and sell. The bill, which is considered a market-based solution to global warming, narrowly passes in the House in 2009, but dies in the Senate in 2010.

In response to legislative inaction, the U.S. Environmental Protection Agency issues finding of harm for GHGs, opening the way for direct regulation of GHG emissions

After thorough study of the scientific evidence, the U.S. Environmental Protection Agency declares that GHG emissions are a public health threat. The finding will allow the agency to finalize GHG standards for light-duty vehicles and also to regulate coal-fired (polluting) power plants.

San Francisco Mayor Newsom announces 100% Renewable Electricity goal

At the commemoration of the newly completed Sunset Reservoir Solar Project (comprised of 24,000 solar panels), the mayor launches an initiative to meet 100% of San Francisco's energy needs with renewables by 2020. A $250,000 grant from the Sidney Frank Foundation will assess how this goal can be achieved.

San Francisco International Airport announces its goal of operational carbon neutrality

In support of Ordinance 81-08, the San Francisco International (SFO) Airport Commission supports the City's initiative and establishes the goal of carbon neutrality by 2020 for airport controlled operations. SFO management has gone above and beyond mandated requirements and developed its own unique Climate Action Plan to achieve this goal.

2011

Potrero Power Plant fully closes

San Francisco meets another Electricity Resource Plan goal by closing Potrero Power Plant, the second dirty, polluting power plant identified in 2002.

Five Community Panels are established to give feedback on the City of San Francisco's Climate Action Plan

The Climate Team in San Francisco's Department of Environment seeks input from five community panels, composed of constituents from across the city. Each panel formalizes its recommendations and endorsements for the Climate Action Strategy Update in a letter, presented to Mayor Edwin M. Lee at the 2011 Green Economic Forum. Copies of all five letters are provided in Appendix G.

In efforts to expand the view of its carbon impacts, the City of San Francisco forges academic partnerships

Three separate studies are conducted in partnership with the University of California, Berkeley, the University of Colorado, Denver, and the Stockholm Environment Institute. The results of these studies show that San Franciscan's consumption choices, particularly in the areas of food, fuels, and infrastructure materials, have a carbon impact that is four times greater than the carbon footprint measured in the original 2004 Climate Action Strategy.

The San Francisco Municipal Transportation Agency (SFMTA) publishes the Climate Action Strategy for the Transportation Sector

In 2007, voters passed Proposition A, requiring SFMTA to create a plan to reduce community-wide transportation emissions. In 2011, SFMTA publishes the Climate Action Strategy for San Francisco's Transportation Emissions, which proposes six mitigation strategies that build on San Francisco's previous work and global best practices. These six strategies, which provide the basis for the transportation goals and policies proposed in the updated Climate Action Strategy, are: (1) travel choices and information, (2) demand pricing, (3) transit-oriented development, (4) transit improvements, (5) complete streets, and (6) electric vehicles.

The San Francisco Department of Public Health releases a Public Health and Climate Risk Analysis report

The San Francisco Department of Public Health publishes a heat wave disaster response plan: the Environmental Health Assessment of Vulnerability to Heat Waves and Air Quality. San Francisco showed specific vulnerabilities during the 2006 California heat wave because of a lack of physiologic and technologic adaptations for extreme heat events, which are expected to increase in frequency and duration with climate change.

The San Francisco Public Utilities Commission updates its Electricity Resources Plan

A clearer picture of how and where energy is being consumed in San Francisco's buildings is emerging, thanks to an increased partnership among key city agencies, including the San Francisco Public Utilities Commission (SFPUC), PG&E, and the San Francisco Department of Environment. With the improved data, a more accurate technical modeling of GHG emissions is possible, and SFPUC issues an update in its Electricity Resources Plan, which includes a carbon-neutral energy goal. The San Francisco Board of Supervisors adopts a resolution endorsing the updated plan.

2012

LEED Gold certification becomes mandatory for all new commercial buildings in San Francisco

San Francisco sets another benchmark for strict municipal green building codes.

The San Francisco Department of Environment completes a third-party verified, GHG emissions inventory for community-wide emissions

An independent, accredited GHG verifier undertakes a technical review of San Francisco's GHG emissions inventory.

The U.S. Environmental Protection Agency's Region 9 releases a study of heath cobenefits and climate action with the City of San Francisco

In addition to producing changes in climate, the burning of fossil fuels affects public health. In response, the San Francisco Department of Environment partners with the U.S. Environmental Protection Agency, Region 9, to conduct an evaluation of the health benefits of reducing local GHG emissions. The study concludes that the Climate Action Plan's reduction measures will result in significant economic benefits (approximately $114 million) from improved health outcomes.

The Port of San Francisco releases a Sea Level Rise Risk Analysis for Port property

The report includes sea level rise projections as well as guidance for adaptation planning.

The U.S. Court of Appeals upholds the U.S. Environmental Protection Agency finding of harm

The U.S. Court of Appeals, District of Columbia Circuit upholds a finding by the U.S. Environmental Protection Agency that GHG emissions endanger public health and contribute to global warming. The challenge to the agency's findings had blocked its ability to target large polluters. The court found the agency is "unambiguously correct," which now clears the way for the agency to regulate GHG emissions on a national level.

The San Francisco Mayor's Renewable Energy Task Force releases its report detailing how to achieve 100% renewable electricity

Mayor's Renewable Energy Task Force produces its recommendations to achieve 100% In late 2010, Mayor Newsom announced a new goal of achieving a 100% renewable electricity supply for San Francisco. In support of this goal, Mayor Lee convened the Mayor's Renewable Energy Task Force in 2011. The Task Force's final report, released in 2012, outlines the major findings from their year of study and provides a comprehensive set of recommendations that will enable San Francisco to meet 100% of its electricity demand with clean resources. Many of the recommendations are consistent with and build on the goals and recommendations of the 2011 Electricity Resources Plan, which called for zero-carbon electricity supply by 2030. Key recommendations from the Renewable Energy Task Force Report include: (1) implementation of a San Francisco Community Choice Aggregation program, Clean Power SF; (2) expanded access to renewable energy through virtual net metering; and (3) increased support for community renewable energy legislation and projects.

2013

San Francisco Department of Environment releases its updated Climate Action Strategy, under Mayor Edwin Lee